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Animal Nursing Auxiliaries

Veterinary surgeons will know that, for some time past, the Royal College of Veterinary Surgeons has had under consideration the possible usefulness of establishing an official Register of "animal nurses": that is, lay assistants whose capability is first assessed and then recognised after formal examination by the College. An official statement, published on another page, announces the inauguration of a Register of Animal Nursing Auxiliaries, and with it a new chapter in our history is opened.

The benefits of this new Register will be obvious to those of our readers who are in practice. In due course they will have, upon call, a body of trained technicians to whose practical experience and theoretical knowledge the College examiners will bear adequate witness. The days when the loss of a valuable lay assistant meant, in all likelihood, a dreary period of training a raw beginner will be over, and the busy practitioner will, for the first time, be in a position comparable with that of his medical colleague having nurses to relieve him of numerous duties and thus sparing his energies for work which can be done only by the qualified professional man or woman. Whether in human or in veterinary medicine, the activities of the principal call for pre- and post-professional attentions to the patient which, while they can be performed by lay personnel, yet call for trained, conscientious and disciplined workers. It is such a body of workers, registered and possessing known and proven skills that this new scheme will provide.

It may be suggested, then, that the practical assets of establishing a Register of Animal Nursing Auxiliaries are self-evident; and the one possible danger, that of future "dilution" of the profession is safeguarded by the 1948 Act which permits the practice of veterinary surgery only by those who are members of the Royal College, or whose names have been entered in the gradually diminishing Supplementary Register.

What remains now is for members in practice to make the best use of the scheme. As will be seen from the official statement it falls, in a sense, into two parts: the first is the examination of lay workers who have been for some time in veterinary employment; the second is the reception into such employment of newcomers. The College does not expect, at the beginning, a large influx of the latter, but once the scheme is published in the lay press, as it shortly will be, there may well be quite a number of young people applying to veterinary surgeons for that period of employment which will supply the practical knowledge upon which they will later be examined. Much of the long term success of the scheme will depend upon the quality of young persons the individual veterinary surgeon thinks fit to take into his or her service, and the amount of useful experience these aspirants will be enabled to acquire. In brief, the hope must be that, with an eye to the future, the main body of practitioners will be determined to play their indispensable part in the creation of a body of Animal Nursing Auxiliaries.

The Royal College, as is made clear, is to be solely the examining body; obviously it could not embark upon courses of instruction; and it will be for keen aspirants to seek theoretical instruction—the broad details of which are set out in a brochure issued by the College—at evening classes, university extension lectures and so on. In view of the fact that the scheme will at first apply to small-animal (*i.e.*, mainly urban practice, this should not prove unduly difficult.

As the scheme proceeds, experience may suggest modifications; and already it is envisaged that Animal Nursing Auxiliaries for large-animal practice will be encouraged at a later date. At its inauguration, however, it may immediately be said that this is a valuable project, one which represents an important forward step in the development of our profession, and whose practical worth should be increasingly evident as time goes on. The College (whose Officers have consulted with the B.V.A. throughout) is to be congratulated.

Congress Paper read in Plenary Session

Veterinary Surgery and Orthopaedics

BY

J. TRUETA

Nuffield Professor of Orthopaedic Surgery,
University of Oxford
The Nuffield Orthopaedic Centre, Oxford

I AM most grateful to the Council of the British Veterinary Association on the occasion of their 79th Annual Congress for offering me the opportunity to bring to the consideration of the members of the Association some reflexions which I believe would be of some benefit to both orthopaedic surgeons and veterinary surgeons alike.

Your profession, like mine, is misnamed by the addition of the word surgery to those really defining our two specialities, veterinary and orthopaedics. If the title names of our professions were right our two fields of action would be narrower than they are, and much of what I propose to tell you to-day would be irrelevant and, at its best, uninteresting. What characterises our two professions is not a particular system of treatment but the knowledge of the normal and pathological anatomy and function of man and animals and the clinical manifestations of disease.

There is little doubt that the great advances of recent times in the control of disease are due more than anything else to technical developments in the laboratories and the enormous use of experimentation in laboratory animals. But in one respect at least there is still great scope for improvement in the medical field, both of the human and animal variety. I refer to the, as yet, very modest understanding of the pathological conditions affecting the subjects of either speciality by the members of the other. My hope to-day is to contribute to lessen the distance between us in the certainty that only benefit will come from the mutual understanding of the problems affecting both of us.

A final introductory word is needed from me to dispel any doubt about my knowledge of animal pathology. This is very limited indeed and for this reason my remarks will be based only on my personal experience as an orthopaedic surgeon handling laboratory animals for the prosecution of my research work. From all these considerations it may be that it is in the common field of pathology, particularly in non-lethal conditions, that you offer to us a rewarding contribution, as we may perhaps help you with some of the more sophisticated techniques developed in our laboratories and with the observations we have made while using them.

From the viewpoint of research you have the advantage of being able to perform your studies, including experiments, on the same species affected by those conditions which are the objects of your interest. We are, of course, barred by the moral principles governing civilised human behaviour from using man as our experimental subject and for this reason we select animals instead, hardly ever the more appropriate for the study in question but the more easily available to us. The laboratory animal is usually the rat, rabbit and guinea-pig; experiments on the dog and cat are infrequent and exceptional in any other species. In general the value of the experimental work done in these animals is limited when their implications are extended to man. Let us take an example of this.

For many decades osteomyelitis in children has been the object of a constant flow of papers both clinical and experimental, and since Hobo (1921) we know that the peculiar vascular pattern in the long bones during growth plays a decisive part in the inception of the disease. We have been able to contribute also to the study of the vascular arrangement responsible for the main characteristics of acute bone infection (Trueta, 1959). But when the experimental evidence of this was sought by inducing osteomyelitis in laboratory animals, the results were uncertain, contradictory or, more frequently, negative. Among dozens of investigators only a few such as Kistler in 1935 and Poursines in 1951 were able to cause bone and joint infections vaguely resembling those found in children. This is explained by the high resistance to staphylococcal bone infection of the common laboratory animals; consequently, when the bacteria concentration inoculated was high enough to cause damage this frequently brought about a lethal bacteraemia, and when directly introduced into the bone caused a massive local infection with little in common with the haematogenous osteomyelitis of children.

The logical answer to these difficulties would be to select the proper animals for each particular type of experiment using only those that in their natural clinical susceptibility were affected by conditions similar to those presenting in man. Thus, information would be gathered about the disputed nature of congenital dislocation of the hip in children if the orthopaedic surgeon and pediatrician had been able to study all the factors, genetic, anatomical and functional, which make the German shepherd dog so susceptible to dislocation of the hip.

To test theories about this condition using animals to which the disease or condition is unknown is unproductive when not misleading. Such is the case when the rat or the rabbit, or even those breeds of dog never affected by hip dislocation are used to find out what really happens in the human.

To follow the appropriate course to investigate vertebral brucellosis in man we should select the swine, for both man and swine are most commonly affected in the spinal column. The swine should also interest rheumatologists and orthopaedic surgeons alike for it is affected by an ankylosing condition of the spine and of the joints of the extremities not very dissimilar to the "ankylosing spondylitis" of man.

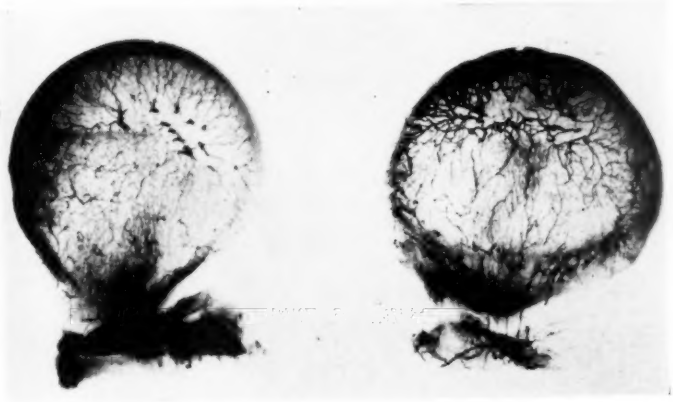

FIG. 1.—Transverse section of a femoral head. A.—Normal head showing a discrete vascularisation. B.—Head affected by advanced osteoarthritis showing a marked hypervascularisation.

FIG. 2.—Angiograph of a femoral head affected by advanced osteoarthritis. Note the profusion of the lateral epiphyseal vessels and their increase in size.

FIG. 3.—Microangiograph of a segment of a femoral head in advanced osteoarthritis. The hyaline cartilage has degenerated and has been invaded by a large number of vessels contributing to form osteophytes.

FIG. 4.—Radiograph of a slab section of an osteo-arthritic femoral head demonstrating how sclerotic the area of weight bearing is.

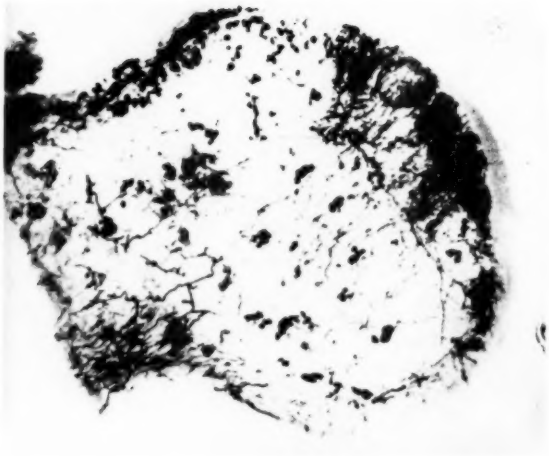

FIG. 5.—The same femoral head after having been injected and decalcified showing profuse vascularity corresponding to the area of bone sclerosis in the previous picture.

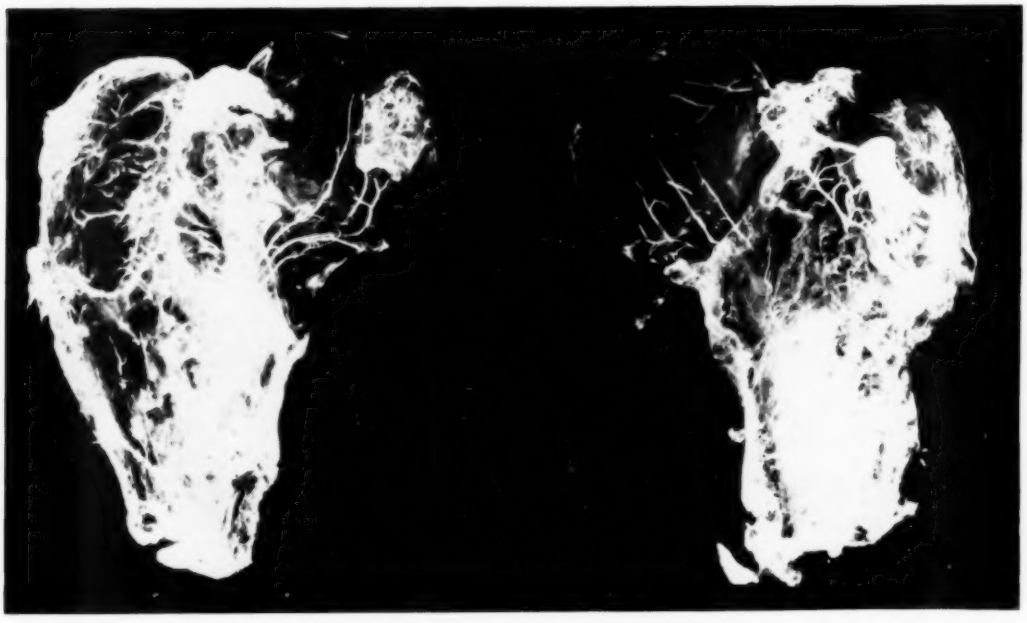

FIG. 6.—White child. New-born baby showing a good injection of the round ligament and of the metaphyseal vessels. In this particular case the lateral epiphyseal vessels are less injected.

FIG. 7.—White child. At less than one month very good injection of the epiphyseal and metaphyseal vessels. Note the absolute lack of injection of the round ligament.

FIG. 9.—White child. Six-year-old femoral head showing the lateral epiphyseal vessels providing almost exclusively the blood for the femoral epiphysis. A single ascending branch from the vessels entering the metaphysis is seen. No round ligament injection is yet detectable.

FIG. 8.—White child. At 3 years the secondary nucleus of the femoral epiphysis is well seen with the lateral epiphyseal vessels and only a remnant of the metaphyseal vessels remaining. No vascularisation from the round ligament into the femoral head is present.

FIG. 10.—White child. Well injected upper femoral epiphysis demonstrating the vasculature just at the time of fusion of the femoral epiphysis. Still the lateral epiphyseal vessels are predominantly responsible for the nourishment of the head but the round ligament vessels are already well developed.

FIG. 11.—Negro child. Femoral head of a 2-day-old baby demonstrating the penetration of vascular branches from the round ligament.

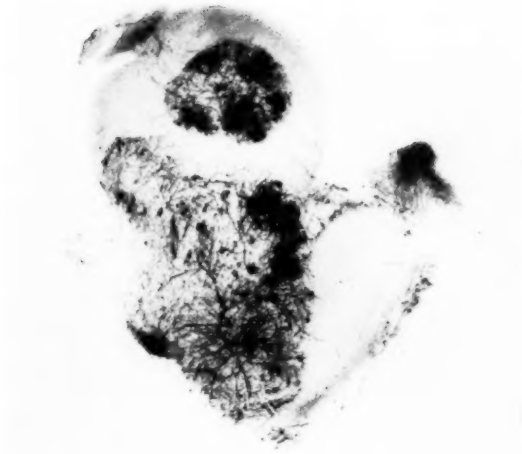

FIG. 12.—Negro child. Child of 1½ years with as many vascular branches coming from the round ligament as from the lateral epiphyseal vessels.

FIG. 13.—Negro child. Only moderately well injected femoral head of a male 1½-year-old child, despite which the round ligament vessels appear almost as important as the lateral epiphyseal vessels.

FIG. 14.—Negro child. A 4-year-old girl demonstrating the excellent supply of the femoral head from the round ligament vessels.

(Figs. 1 to 10 are reproduced by kind permission of the Editor of the J.B.J.S.)

Other characteristics make this species interesting to human medicine; and among them I should mention the anatomy of the skin with its sweat glands, as in human skin, and its eyes which ophthalmologists find to contain human elements. Thomasen (1939) has described an osteochondritis of the shoulder in swine resembling human "Perthes." I abstain from commenting upon the possible implications of these curious similarities between the human and the swine for these could lead me to unwarranted conclusions.

So far I have only referred to some data supporting the thesis that a better knowledge of animal pathology could be of benefit to medicine in general and to orthopaedic surgery in particular. I shall now consider a couple of examples of the possible way in which studies made in medical laboratories and experimental units can assist the veterinary surgeon. Of both I have personal experience.

The first is osteoarthritis. A decade ago we began an investigation of this condition, now perhaps the most frequent affecting man. As an orthopaedic surgeon I was interested in enlarging our knowledge of the origin and early phase of this disease, for we were requested to treat it once it had reached what is depressingly known as its "surgical stage."

In our investigation we used only human material collected both clinically and *post mortem*. Soon we confirmed that the cause of the articular decay was located always in the joint cartilage but that the reason was not the "wear and tear" as it is ordinarily thought, but the defective nutrition of the cartilage cells due to wrong function of the joint. Consequently, due to the improper distribution of pressures, the less compressed part is the first to suffer. This was found to be due to the stagnation of the transudates and synovial fluid into the cartilage when the repeated squeeze of intermittent pressure was lacking. In this respect prolonged immobilisation is causative of ostoarthritis as it provides excessive overaction of some muscles over their antagonists. After this it was considered of interest to study the part that hypervascularisation plays in the production of osteophytes and in undermining the bone structure of the joint. This finding was made possible by the use of methods of vascular perfusion which showed that, contrary to current views, the trouble in the bone is not one of ischaemia but of over-vascularisation (Figs. 1 to 5).

Since these findings were made about 10 years ago, we have studied the localisation and pathological characteristics of osteoarthritis in livestock, and like Callender and Kelser (1938) we found in the equinae osteoarthritis comparable to that of man. It presents itself in ageing horses but not, as in man, in the hip. But according to Haakenstad (1953) osteoarthritis of the hip may be seen in Døle horses which present a flatness of the acetabulum equal to that in many women also affected by osteoarthritis.

Degenerative arthritis of a nature similar to that in man is also seen in the knees of foals, and the anatomical changes observed are related to the slight displacement of the patella. This is due to the faulty development of the lateral condyle, the imbalance of pressure being the causative factor as in man.

Summarising: the conclusions of the etio-pathological studies of osteoarthritis in man may be extended to the majority of animals, the same factors causing the same effects. I would thus expect that the same treatment may be similarly effective in both the members of the animal kingdom and in man.

Let me now mention another field where the contribution of the veterinary surgeon would be decisive in clarifying a condition whose etio-pathology is still disputed in man. I refer to the type of hip osteochondritis known by the name of the 4 men who first described it: Legg-Calvé-Perthes-Waldenstrom, or Legg-Perthes in short. As you may be all aware, since its first description by Legg in 1909 the condition has been assumed to be due to some vascular disorder occurring during the early phase of growth of the upper femoral epiphysis. Despite innumerable investigative attempts even to-day proof is still lacking of the real nature of the disorder, even if microscopical evidence suggests that necrotic changes occur in the secondary nucleus of the femoral head.

In an endeavour to contribute to the elucidation of this problem we have been working for some years on the vascularisation of the femoral head of children from birth to maturity and we have published several papers on our findings (see bibliography). The most relevant seems to be the absence of penetration of the round ligament vessels until the age of 6 or 7 years with marked familial and individual differences. We have evidence of this, for in over 60 well-injected femoral heads of white children in our collection no vascular penetration from the ligamentum teres before the age of 5 was found. On the other hand, until the age of 3 or 4, enough vessels penetrate the femoral head from below the growth cartilage to constitute a complementary source of blood supply to the lateral epiphyseal vessels capable of preventing any ischaemia if the latter were interrupted (Figs. 6 to 12). But over the age of 4 to 5 the reduction of the blood flow from below the area of the growth plate and the absence as yet of the round ligament blood supply leaves the femoral epiphysis totally dependent on the lateral epiphyseal vessels for its nourishment. Any damage to these vessels, or even a relatively short interruption of their blood flow, may account for the necrotic lesions we see in biopsies of the femoral head affected by the so-called Perthes disease.

In the course of our investigation we found that children from Negro stock were seldom affected by this hip dysplasia and it occurred to us that perhaps the Negro children have a better preservation of the round ligament vessels than their white brothers, for we know that vessels penetrate the cartilaginous femoral head up to the age of 3 months in the European child.

To clarify this we requested the help of colleagues* who work in areas with Negro populations and found that the vessels from the ligamentum teres were seen permeating the femoral head at the age of 1½, 2, 3 and 4 years. This limited investigation seems to support our suspicion (Figs. 11 to 14).

We were then interested in studying any animals which could present a condition similar to the osteo-

* We thank Dr. S. Shulman of (then) Johannesburg and Dr. Nova Monteiro of Rio de Janeiro for their kind help in sending to us injected femoral heads of Negro children.

(*Concluded at foot of col. 1 overleaf*)

Symposium: Salmonellosis in Man and Animal

1.—Salmonellosis in Calves

BY

E. A. GIBSON

Veterinary Investigation Centre, Norwich

SUMMARY.—The chief causes of salmonellosis in calves are Salm. dublin *and* Salm. typhimurium. *Secondary factors are also important. Calves may be infected* in utero *or at any time during calfhood. The clinical signs of infection are variable, and include stillbirth and neonatal losses, acute septicaemia in young calves, and more prolonged illness, with diarrhoea, or pneumonia or arthritis, or any combination of these, in older calves. Other cases are subclinical. Very few calves remain carriers of the organism.*

The epidemiology of the disease in various kinds of herd is discussed. Adult carriers are an important source of both Salm. dublin *and* Salm. typhimurium, *but the latter can also originate from other host species. The rôle of rats and of feeding-stuffs and fertilisers is discussed. Purchased calves may introduce infection.*

Infections with Salm. typhimurium *are of considerable public health significance and spread from calves to man may be more common than is generally thought. Dogs may transmit infection from calves to man.*

Diagnosis and treatment are discussed. It may be possible to avoid infection by buying calves locally. In closed herds, prevention hinges on the identification and elimination of carriers, and national control measures on these lines should be considered.

* Papers presented to the Annual Congress of the British Veterinary Association in Oxford on Thursday, September 7th, 1961.

Introduction and Historical Survey

CATTLE of all ages may become infected with various salmonella organisms which may give rise to either clinical or subclinical infection. In adults and yearlings clinical salmonellosis is usually sporadic. Affected animals typically show signs of septicaemia followed by profuse diarrhoea or dysentery, and death commonly occurs within a few days of the onset of symptoms. In calves the disease tends to spread rapidly and often reaches epidemic proportions; symptoms are more variable and may include pneumonia or arthritis, and the course is often more prolonged.

Salmonella infection in cattle was recognised on the continent of Europe and elsewhere, both in young stock and in adults, many years earlier than in Great Britain. The various stages of its emergence as a separate entity have been reviewed by Savage (1918, 1920) and by Henning (1939, 1953*a*).

The early history of the disease is confused due to the fact that the salmonella group and its constituent members were at that time inadequately defined. This confusion was increased by the lack of a standardised nomenclature. Although the earlier reports must, therefore, be interpreted with caution, it is nevertheless apparent that bovine salmonellosis has existed as a clinical entity for many years. The organisms isolated by earlier workers are probably the same as those found in the present day.

A form of "calf diarrhoea" or *Kälberruhr*, with symptoms closely resembling those of salmonellosis, has been recognised for at least 150 years. Obich (1865) was apparently the first to regard the disease as due to an infectious agent, but it was not studied bacteriologically until Jensen (1891, 1893) investigated an outbreak in Denmark and isolated an oval coliform bacillus from the viscera of affected calves.

Veterinary Surgery and Orthopaedics.—*Concluded.*

chondritis in children and found that some Terriers and Poodles were occasionally affected by it. As osteochondritis is not a lethal disease either in man or in the animal we pleaded for information to our veterinary colleagues as to the possible different vascular pattern of the dog breeds suffering from "Perthes" but we have as yet been unable to inject any Terrier or Poodle with osteochondritis. The reason is obvious. Not being a lethal condition no one seems ready to agree to having a dog destroyed to examine its vessels even though this could be of importance in bringing light and hope to children affected for years by a perhaps preventable or rapidly curable disease.

I cannot abuse your time any further, but must in closing repeat what I said at the beginning. Our increased collaboration would enhance our understanding of many of the medical and veterinary problems to the benefit of our respective professions. Perhaps one day this will be recognised by the University authorities and a course of animal pathology would form part of the normal curriculum of the medical schools. But until that day comes we should profit by any opportunity which may present itself to maintain a close collaboration with each other.

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Jensen was unable to distinguish the organism morphologically and culturally from strains of *Bacterium coli* (now renamed *Escherichia coli*) recovered from the intestines of normal calves, but found that unlike the latter it was pathogenic for newly born calves, reproducing the disease when fed to them in milk. Similar outbreaks were investigated in Holland by Thomassen (1897) and Poels (1899) who isolated bacteria which they named " pseudo-typhoid bacilli " and " pseudo-coli bacilli " respectively. Jensen (1903) used the term *Bacillus paracoli*, or " paracolon bacillus," for the organism isolated from the Danish outbreaks, but further work showed, with increasing exactitude, that many of the organisms given this name were, in fact, salmonellae (Titze & Weichsel, 1908; Uhlenhuth & Hubener, 1913; Jensen, 1913; Christiansen, 1915). Most appeared to be *Salm. enteritidis* but some resembled *Salm. paratyphi* B (Jensen, 1913).

Other reports incriminating *Salm. enteritidis* as the cause of losses in calves were made by a number of workers, including Miessner and Kohlstock (1912), Luxwolda (1913), Christiansen (1914*a*), Warnecke (1914), Douma (1916) and Meyer, Traum and Roadhouse (1916).

This, however, was before White (1930) established the separate identity of *Salm. dublin* by distinguishing it from *Salm. enteritidis*, which it closely resembles both biochemically and serologically. Subsequently, it was found that many strains previously regarded as *Salm. enteritidis* were *Salm. dublin* (Smith & Scott, 1930; Rajagopalan, 1938). Smith and Scott also re-examined 6 strains of *B. paracoli* isolated in Copenhagen from cases of calf dysentery and found that all 6 were *Salm. dublin*.

Similar confusion existed regarding *Salm. paratyphi* B and *Salm. typhimurium*, because although Savage (1909) concluded that "*B. paratyphosus* B" and "bacilli of the aertryke type" were serologically distinct this view was not accepted by many workers on the continent of Europe until about 1920 (Savage & White, 1925). White (1926) re-examined a number of strains isolated in Copenhagen from cases of salmonellosis in calves and described by Christiansen (1914*b*) as " *B. paratyphosus* B (Schottmüller) " (*i.e. Salm. paratyphi* B). All were found to be typical strains of *Salm. typhimurium*.

When the salmonella group had been more clearly defined, it became apparent that the organism most commonly associated with bovine salmonellosis in those parts of Europe in which the disease was endemic was *Salm. dublin*. *Salm. typhimurium* was next in order of frequency, being found in some cases in adult cattle and in a few cases in calves, while other salmonella types were incriminated only occasionally. In other parts of Europe, where bovine salmonellosis was uncommon, *Salm. typhimurium* tended to be the predominant organism (Bartel, 1938; Lütje, 1939). Thus *Salm. dublin* was found to be the predominant salmonella infection of calves in Germany (Röhrer & Winand, 1941; Pohl, 1952); Holland (Clarenburg & Vink, 1949); Denmark (Hansen, 1947) and Italy (Strozzi, 1934). A similar preponderance of *Salm. dublin* infection has been reported from various non-European countries including South Africa (Henning, 1939), Venezuela (Gallo, 1939) and Brazil (Penha & D'Apice, 1946).

The earliest references to bovine salmonellosis in Britain are to be found in reports in the medical literature of certain outbreaks of salmonella food poisoning in man which were traced to infected cattle. Thus Savage (1920) cited 7 outbreaks, occurring between 1894 and 1914, in which the infection was milk-borne and may have originated from infected cattle. In 2 instances a cow in the herd supplying the suspect milk was ill at the time of the outbreak, but unfortunately in no instance was a bacteriological examination of the dairy herd undertaken. Bacteriological confirmation was obtained, however, in a milk-borne outbreak that occurred in Newcastle upon Tyne in 1913 (Kerr & Hutchens, 1914). A similar outbreak had occurred here in 1910, when an organism identified as " *B. enteritidis* Gärtner" was isolated from the milk. It is of interest to note that re-examination of this organism by Smith and Scott (1930) showed it to be *Salm. dublin*.

The first reference in the veterinary literature to the occurrence of bovine salmonellosis in Britain was by McAllan and Howie (1931) who referred to 3 cases in adult dairy cows in Aberdeenshire. Again, these outbreaks were disclosed during the investigation of the outbreaks of human salmonellosis to which they gave rise.

Shortly afterwards, Bosworth and Lovell (1931) reported 2 outbreaks of *Salm. dublin* infection in calves. It is interesting to note that these exemplified the diversity of clinical signs that may be shown by calves suffering from salmonellosis. Thus one outbreak was characterised by acute diarrhoea, with fluid, offensive faeces. Some of these calves also developed pneumonia, but in the second outbreak the predominent clinical signs were those of pneumonia, and diarrhoea was not observed. A further outbreak of *Salm. dublin* infection in calves was reported by Craig, Davies and Massey (1941). Both the adult and calfhood forms of bovine salmonellosis were reviewed by Field (1949*a*).

Calfhood Salmonellosis in Britain

For the purpose of this paper calfhood will be defined as the first 6 months of life.

Epidemiologically, there are 2 main forms of the disease in Britain.

The first occurs in areas, such as those in South Wales, in which *Salm. dublin* infection is endemic in adult and yearling cattle. A brief description of the disease in these older animals is therefore apposite. Some show typical symptoms of clinical salmonellosis, with pyrexia, acute depression, anorexia and cessation of milk secretion, followed by profuse diarrhoea or dysentery (John, 1946; Field, 1948, 1949*a*). Some 50 to 70 per cent. of the affected animals die within one to 5 days of the onset of symptoms. Non-fatal cases make a slow clinical recovery, but invariably continue to excrete *Salm. dublin* in the faeces. Such animals will be referred to in this paper as " constant excretors." Other cattle may become constant excretors as the result of a very mild or sub-

clinical infection. Others may show only intermittent excretion of the organism, and the term "active carriers" will be used as comprising both constant and intermittent excretors. Other cattle are believed to acquire a latent infection which may be disclosed by excretion of the organism when the animal is put under stress by, for example, the presence of intercurrent diseases such as piroplasmosis or intestinal parasitism (Gibson, 1958). These will be referred to as "latent carriers." Adults or yearlings showing any of these manifestations of salmonellosis can act as a source of infection to calves, which may be exposed to infection at any age from birth onwards, or even *in utero* (Field, 1948; Rasch, 1953).

The endemic areas that have received most study as yet are those in South Wales (Field, 1948, 1949*a*, 1949*b*; Gibson, 1958). Here most of the farms are small, with little hired labour. The herds tend to be small, and have few calves at risk at any one time. Under these conditions calfhood salmonellosis typically produces sporadic deaths in young calves, or chronic unthriftiness, or mild or even subclinical illness.

This is in marked contrast to the second epidemiological form of the disease which typically occurs among large batches of purchased calves. These are often found on premises where there are no older cattle. Under these conditions the disease tends to take a severe course, with high morbidity and mortality, and sometimes affects successive batches of calves.

Aetiology

The causal organism

Buxton (1957*a*), in a list that did not claim to be exhaustive, referred to 28 salmonella serotypes as having been isolated from cattle. Table I, which shows the isolations made from calf material at Veterinary Investigation Centres during the 3 years of 1958-60, lists 14 serotypes, 7 of which were not included in Buxton's list. It will be seen, however, that 2 serotypes, *Salm. dublin* and *Salm. typhimurium* account for 96 to 97 per cent. of the isolations. The

TABLE I
SEROTYPES ISOLATED FROM CALF MATERIAL AT VETERINARY INVESTIGATION CENTRES IN ENGLAND AND WALES

	1958	1959	1960
	per cent.	per cent.	per cent.
dublin	72 (58)	229 (62)	272 (64)
typhimurium ...	48 (39)	127 (34)	138 (32)
other serotypes ...	3 (2·5)	13 (3·5)	16 (3·5)
comprising :—			
agama	–	1	3
bovis-morbificans	1	–	–
brancaster ...	–	–	1
enteritidis ...	1	3	5
give	–	1	–
heidelberg ...	–	1	–
menston ...	–	–	1
pullorum ...	1	1	1
reading... ...	–	1	–
saint-paul ...	–	1	1
tennessee ...	–	–	1
thompson ...	–	4	2
unidentified ...	–	–	1
Total ...	123	369	426

data from which this table was compiled did not distinguish between clinical and subclinical infection. Probably if one included only those isolates associated with clinical disease these 2 serotypes would be even more predominant.

As stated above, earlier studies in continental Europe have also shown *Salm. dublin* and *Salm. typhimurium* to be the predominant serotypes in calves, although the relative incidence of *Salm. typhimurium* infection has invariably been lower than that shown by Table I. More recently, Müller (1958) reported that *Salm. dublin* and *Salm. typhimurium* comprised 74 and 14 per cent. respectively of 229 isolates from calves, but he also found a high incidence of infection with exotic serotypes, in that 28 (12 per cent.) of the isolates belonged to 17 different serotypes.

These variations in the incidence of the main serotypes probably reflect differences in methods of calf husbandry and in the general pattern of livestock enterprise at the various times and places at which the surveys were made.

It is to be expected that *Salm. dublin* should be the predominant serotype in calves in those areas of Britain where salmonella infection is endemic in adult and yearling cattle since studies of such an area by Field (1948, 1949*a*, 1949*b*) and Gibson (1958) showed that *Salm. dublin* was the predominant serotype in these older cattle and that calfhood infection was invariably associated with the presence of active carriers among the adult cattle. Field (1948) found *Salm. dublin* infection in 66 herds, but *Salm. typhimurium* in only 4. Gibson (1958) surveyed 3,569 cattle on 142 farms in Carmarthenshire. Twenty-seven cattle (0.8 per cent.), deriving from 20 (14 per cent.) of the farms, were active carriers of *Salm. dublin* but none yielded *Salm. typhimurium*. *Salm. dublin* infection of calves was diagnosed in 5 of the 20 herds in which active carriers were present, but was not found in the absence of infection in adult cattle. *Salm. typhimurium* was isolated only once, from a calf that appeared clinically normal. No other serotypes were isolated either from calves or adults.

The factors influencing the infection of purchased calves with various serotypes are evidently more complex, and will be discussed in a later section. At this stage it will suffice to say that although *Salm. dublin* remains the predominant serotype, the proportion of cases due to *Salm. typhimurium* infection is higher in purchased calves than in home-bred ones. Some batches show a dual or multiple infection, as do some individual calves.

Many of the observations offered in this paper are based on studies of *Salm. dublin* infection. However, unless the contrary is expressly stated in the text, they may be read as applying to salmonellosis in general, since it appears that calfhood infection with *Salm. typhimurium* and other serotypes closely resembles that with *Salm. dublin* (Field, 1948; 1959).

Other aetiological factors

It would be wrong to leave the impression that the causal organism is the only aetiological factor worthy of consideration. The literature on salmonellosis in animals abounds with references to the aetiological

significance of various managemental factors and the presence of intercurrent disease (Buxton, 1957*a*). Many similar references are found in accounts of the disease in calves, including those by Dupont (1932), Henning (1939), Guerrero (1943) and Field (1959). Under British conditions secondary factors are undoubtedly involved in many outbreaks among purchased calves. They include travel weariness; chilling; the dietary changes that inevitably accompany a change of ownership, and the presence of intercurrent infections such as so-called "virus pneumonia." They were discussed at some length by Buxton (1960). It would seem that these secondary aetiological factors act either by making calves more susceptible to infection by the organisms in their environment or by activating infections that they have already acquired. The result can be the production of a severe outbreak from an infection that would otherwise have produced only mild or subclinical disease.

Manifestations of Infection

Clinical symptoms

The clinical symptoms of calfhood infection with *Salm. dublin* are very variable. The manifestations of the disease form a gradation that includes abortion, stillbirth, neonatal death, acute disease in young calves and more chronic disease in older ones. There is also marked variability in the manifestation of infection in any one age group.

Pregnant cows that develop clinical salmonellosis commonly abort their calves (Olson, 1939; John, 1946). Field (1948) stated that abortion generally occurs even in those cases in which symptoms are less severe than usual. The calves of active carriers may also be aborted, the causal organism being recoverable from the foetus by cultural examination (Bert, 1943; Field, 1948; Gibson, 1958). Intra-uterine infection may also result in stillbirth or in the production of calves that are weakly at birth and die shortly after (Field, 1948; Geurden, Devos & De Vos, 1949). Calves of active carriers that are not infected *in utero* may acquire infection during the first week or two of life. Such cases are rarely fatal and are commonly subclinical, presumably because of the protective action of antibodies received in the dams' colostrum. They may, however, transmit infection which gives rise to more severe illness in calves in contact with them.

An acute septicaemic form of the disease may develop when the calf of an apparently uninfected cow, without the colostral antibodies referred to above, acquires infection soon after birth. This is especially likely to occur when a cow calves in the cowshed in close proximity to an active carrier. Field (1948) described such calves as being strong and healthy for the first 24 to 36 hours of life, but then showing progressive dullness, inappetence and recumbency, and dying 3 to 5 days after birth. He stated that this form of the disease was encountered only in herds in which adult carrier animals were known to be present.

The clinical picture shown by older calves is more variable. Only a few of the cases observed by the author in South Wales showed an acute form in which calves died during the first or second week of life, after 3 to 5 days of pneumonia and/or diarrhoea. Cultural examination disclosed a septicaemic infection with *Salm. dublin*. Other calves, in which infection was diagnosed both from their excretion of the organism and from their subsequent production of flagellar agglutinins, showed no observable clinical symptoms. Others showed only transient pyrexia and diarrhoea, sometimes with transient inappetence. Others developed a chronic diarrhoea, with light-coloured pasty faeces, resembling soft putty and commonly streaked with mucus or blood. These calves became unthrifty and were sometimes permanently stunted. A more fluid diarrhoea, with brown offensive faeces, was also seen. In others pneumonia was present, in some cases as the only clinical manifestation of the disease. Others developed swellings of the carpal or tarsal joints. This arthritis, which was accompanied by marked lameness, tended to move from one limb to another.

It must be emphasised that the clinical picture described above was seen in home-bred calves receiving a milk diet. There were rarely more than 4 or 5 calves at risk, with the result that there was little opportunity for passage of the organism from one calf to another.

The disease tends to be more severe when it occurs among the larger batches of calves that are found at risk in East Anglia and elsewhere. The symptoms show a similar variability, but the enteric form of the disease is predominant. Typically there is yellow or brown diarrhoea "scalding" the perineal skin and matting the hair of the tail and thighs. The faeces commonly contain mucus or small blood clots. The affected calves are dull, and rapidly become emaciated, although appetite is not completely lost. Some make a protracted recovery, while in fatal cases death is preceded by a short period of increasing weakness and prostration. In some cases the appearance of the calf varies greatly from day to day, it being recumbent one day and in good spirits the next. Other calves die from a salmonella septicaemia without showing diarrhoea. Examination of in-contact calves usually discloses that some have a subclinical infection.

When large numbers of purchased calves are at risk the infection may confine itself to one or two pens or spread to affect most of the calves. In the latter type of outbreak, observed chiefly with *Salm. dublin* infection, the mortality may reach 60 per cent. or more, the survivors being stunted and unthrifty. Such outbreaks commonly show an intercurrent infection with so-called "virus pneumonia."

Excretion of the causal organism

Bacteriological examination of rectal swabs or faeces samples indicates that even when calves show the enteric form of the disease excretion of the organism tends to be intermittent. This is in marked contrast to the constant excretion shown by typical clinical cases in adults and yearlings (see Fig. 1, C). Transient diarrhoea is often accompanied by excretion of the organism (see Table II). Faecal excretion of *Salm. dublin* is especially sparse in calves

showing the pneumonic or arthritic forms of the disease (see Fig. 1, A and B respectively).

Calves that recover clinically from infection with either *Salm. dublin* or *Salm. typhimurium* invariably cease to shed the organism in their faeces. Field (1959) stated, however, that exceptionally a calf may remain an active carrier into adult life; an observation supported by Henning (1953*b*). Gibson (1958) suggested that some calves may remain latent carriers of the organism, and that in a few cases this latent infection may later, in adult life, be activated by various factors to give rise to typical symptoms of the disease as it occurs in adult cattle. This mechanism would seem to be more likely in calves that experience a mild or subclinical infection.

The serological response to infection

Most calves that experience either a clinical or subclinical infection with *Salm. dublin* respond by the production of flagellar agglutinins, those with clinical symptoms generally showing higher titres than those with subclinical infection. Calves less than 4 months old show little or no production of somatic agglutinins. Fig. 1 shows the serological response of 2 clinically affected calves and contrasts this with the typical response of an adult cow, in which high levels of both flagellar and somatic agglutinins were produced.

TABLE II

EXCRETION OF *Salm. dublin* BY A GROUP OF THREE CALVES

Reference No. of calf :—	51	52	53
Age when first examined on March 27th :—	10 days	7 days	2 days
March 27th	*S.d.*	–	*S.d.*
April 4th	–	–	*S.d.*
April 6th	–	–	–
April 8th	–	–	*S.d.*
April 13th	*S.d.*	–	*S.d.*
April 14th	*S.d.***	*S.d.*	*S.d.*
April 17th	–	–	–
May 4th	–	–	–

S.d. = *Salm. dublin isolated.*
– = Cultural examination negative
** Symptoms (pyrexia and diarrhoea) of Salmonellosis.

Pathological changes

Calves dying from acute salmonellosis show epicardial haemorrhages and other evidence of a septicaemic infection. The causal organism is readily isolated as a heavy pure growth from the parenchymatous organs but the rectal faeces commonly fail to yield salmonellae.

More prolonged cases are characterised by poor bodily condition, usually with evidence of a fetid diarrhoea. The small intestine typically shows a diffuse mucoid or muco-haemorrhagic enteritis and the mesenteric lymph nodes are oedematous, congested and greatly enlarged. A severe haemorrhagic and diphtheritic enteritis has been seen in some cases of *Salm. typhimurium* infection. The liver commonly shows a jaundiced or mahogany-like colour, with thick, turbid, golden-coloured bile. Sharply defined areas of pneumonia are commonly present in the anterior lobes of the lungs. Outbreaks have been reported in which pneumonia was the predominant finding *post mortem* (Bosworth & Lovell, 1931). When the joints are affected the joint cavities and adjacent tendon sheaths contain a gelatinous or serofibrinous fluid.

Earlier reports from the continent of Europe commonly referred to the presence of necrotic foci in the liver and kidneys of calves dying from sub-acute salmonellosis (Langer, 1904; Hutyra, Marek & Manninger, 1949) but in the author's experience these are not commonly found in cases occurring in Britain.

Usually the causal organism is readily isolated from the intestinal tract and its associated lymph nodes, and from the liver and bile. Many cases show a terminal septicaemia. In some cases of *Salm. typhimurium* infection, however, death may occur from cachexia after the causal infection has regressed, and it may not be possible to isolate the organism from sites other than the mesenteric lymph nodes.

The Incidence of Salmonella Infection in Calves

General incidence

During recent years there has been an apparent increase in the incidence of salmonella infection in calves (Ingram & Lovell, 1960; Buxton, 1960; Sojka, 1961). The data shown in Table I also support this statement. Part of this apparent increase may be due to additional awareness of the disease, but it seems likely that the greater part of it represents a true increased incidence of infection among purchased calves. This probably reflects the increased traffic that has followed the demand for young calves for rearing as beef—largely on milk substitutes or early weaning systems.

The present extent of the problem is indicated by the interim results of a survey of calf losses conducted by the Veterinary Investigation Service (unpublished data). These show that salmonellosis was diagnosed as the cause of death in 337 (16 per cent.) of 2,084 calves examined *post mortem* at Veterinary Investigation Centres in England and Wales during the 12 months of November 1959 to October 1960 (see Table III), the incidence found at the individual laboratories ranging from 2 per cent. in North West England to 32 per cent. in the West Midlands.

TABLE III

THE SEASONAL INCIDENCE OF SALMONELLOSIS IN CALVES

As shown by the examination of calf carcases at Veterinary Investigation Centres in England and Wales.

Period	Number of calves examined	Number in which Salmonellosis was diagnosed as the cause of death	
			per cent.
Nov. 1959–Jan. 1960	717	184	(26)
February–April, 1960	734	63	(9)
May–July, 1960	311	35	(11)
August–October, 1960	322	55	(17)
Total ...	2,084	337	(16)

Seasonal incidence

Table III indicates that fatal calfhood salmonellosis is more common in autumn and winter than in spring and summer. Table IV is based on a wider range of specimens, comprising viscera and rectal swabs as well as carcases, and including infections that were of only secondary significance. Nevertheless it too shows a lower incidence during the late spring and summer.

This seasonal incidence probably reflects seasonal variations in the calf population, in the amount of traffic in calves and in the various adverse environmental factors, such as cold and damp, that have been described above as secondary aetiological factors.

TABLE IV
THE SEASONAL INCIDENCE OF SALMONELLOSIS IN CALVES
As shown by the number of incidents diagnosed at Veterinary Investigation Centres in England and Wales.

	1958	1959	1960
	per cent.	per cent.	per cent.
January	5 (4)	25 (7)	35 (8)
February	1 (1)	17 (5)	39 (9)
March	6 (5)	16 (4)	48 (11)
April	3 (2)	5 (1)	24 (6)
May	2 (2)	17 (5)	29 (7)
June	3 (2)	15 (4)	21 (5)
July	1 (1)	17 (5)	26 (6)
August	8 (7)	18 (5)	28 (7)
September ...	12 (10)	44 (12)	42 (10)
October	22 (18)	61 (17)	61 (14)
November ...	31 (25)	66 (18)	46 (11)
December ...	29 (26)	68 (19)	26 (6)
Total ...	123	369	425

Age incidence

As has been described above in the section on clinical symptoms, calves may become infected *in utero* or at any time during calfhood (0 to 6 months of age). Field (1948) reported an outbreak affecting 2 six-month-old calves. The disease resembled that seen in younger calves, whereas 2 nine-month-old animals affected in another herd developed the adult form of the disease.

The general age incidence of the disease is illustrated by Table V which, like Table III, refers to cases in which salmonellosis was diagnosed as the primary cause of death. It will be seen that, in contradistinction to *E. coli* infection, salmonellosis was more prevalent after one week of age than in the first week of life.

TABLE V
THE AGE INCIDENCE OF SALMONELLOSIS IN CALVES
As shown by diagnoses made from calf carcases examined at Veterinary Investigation Centres in England and Wales, November 1959–October, 1960.

Age	Number of calves examined	*E. coli* infection	Salmonellosis	Other findings
		per cent.	per cent.	
Under 3 days	107	54 (50)	3 (3)	50
3–7 days	255	144 (56)	10 (4)	101
1–4 weeks	807	213 (26)	157 (19)	437
1–3 months	551	74 (13)	126 (23)	351
3–6 months	273	21 (8)	12 (4)	240
Total ...	1,993	506 (25)	308 (15)	1,179 (59)

Epidemiology

Salm. dublin shows a considerable degree of host specificity in that it is primarily a pathogen of cattle. It occasionally causes outbreaks of abortion in sheep (Shearer, 1957; Watson, 1960) and, as in Scandinavia (Wramby, 1937; Momberg-Jørgensen, 1949), can be an important cause of losses in silver foxes and other fur-bearing animals. It is, however, uncommon in other species. Table VI shows that 914 (94 per cent.) of 969 strains of *Salm. dublin* isolated at Veterinary Investigation Centres in the 3 years of 1958-60 were from cattle. It will be appreciated that because of this degree of host specificity the most likely source of *Salm. dublin* infection in calves is contact, direct or indirect, with other infected cattle.

TABLE VI
THE HOST DISTRIBUTION OF *Salmonella dublin*
As shown by the number of incidents diagnosed at Veterinary Investigation Centres in England and Wales.

	1958	1959	1960	Total
	per cent.	per cent.	per cent.	per cent.
Cattle ...	118 (90)	454 (96)	342 (93)	914 (94)
Sheep ...	4 (3)	13 (3)	14 (4)	32 (3)
Pigs ...	2	1	2	5
Poultry ...	1	4	3	8
Horses ...	1	–	2	3
Mink ...	5 (4)	–	–	5
Miscellaneous	–	–	3	3
Total ...	131	472	366	969

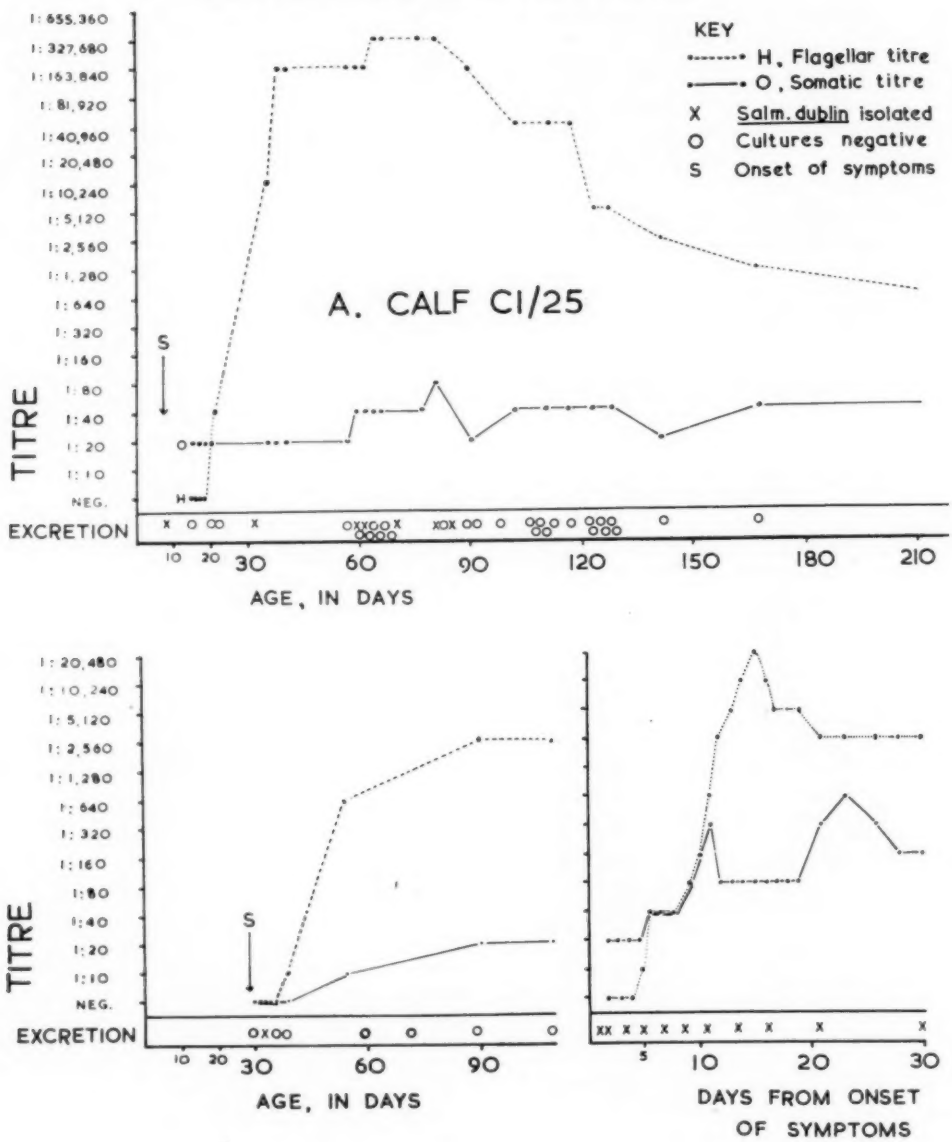
This is not true of *Salm. typhimurium*, since this serotype shows a complete lack of host specificity. Because of this, any investigation of *Salm. typhimurium* infection must include not only cattle but also a wide range of other host species. This also applies to most of the miscellaneous serotypes occasionally isolated from cattle.

Salm. dublin infection in self-contained herds

As stated above, it appears that in areas in which *Salm. dublin* infection is endemic in adult cattle practically all the calfhood infection with this serotype is due to direct or indirect contact with infected cattle. These may be clinically affected animals, or, more commonly, recovered clinical cases or other active carriers of the organism. Field (1948) encountered the septicaemic form of calfhood infection only in herds in which adult carriers were known to be present. Gibson (1958) found calfhood infection in 12 herds. All 12 either contained active carriers or had recently experienced clinical salmonellosis in adult cattle, although no evidence of infection was found in the calves in 21 other herds with a similar history of infection in adult stock.

Calfhood infection could also derive from contact with latent carriers showing transient excretion of the organism due to the presence of intercurrent disease or some other activating factor. Such a latent

FIG. 1.—The serological response to *Salm. dublin* infection.



carrier would probably show normal levels of blood agglutinins and fail to yield salmonellae from the faeces at subsequent examinations of the herd.

The presence of intermittent excretors or of latent carriers that had shown a brief period of activation would provide an explanation for those outbreaks in calves in which examination of the adult herd discloses no apparent source of infection (Miessner & Koebe, 1931; Field, 1948; Müller, 1957).

Once calves have become infected the disease may establish itself in the calf houses and persist for long periods without the introduction of further infection from the adult herd. The outbreak described by Craig *et al.* (1941) was probably of this kind.

Until recently it has been assumed that infection with salmonellae is usually by the oral route. Moore (1957) studied the spread of *Salm. enteritidis* infection among guinea-pigs in a contaminated environment, and found that the conjunctiva was apparently the chief portal of entry, but it is not yet known to what extent his findings can be applied to salmonellosis in cattle.

Infection can be by direct contact with infected animals or through the agency of contaminated premises, boots, brushes, feeding utensils, food, water, etc. Gibson (1958) studied the survival of *Salm. dublin* under various conditions. Samples of faeces from cows that were constant excretors of the organism were deposited on soil and on grass, on the surface of a stone wall and in jars of tap water and of pond water. The organism was isolated for up to 150, 163, 307, 165 and 115 days respectively. Samples stored in petri dishes and glass jars yielded *Salm. dublin* for up to 160 and 412 days respectively. These results suggest that the organisms in infected faeces out of doors probably die out within 6 months, while those in faecal splashes on walls may survive for up to 10 months in the absence of adequate cleaning and disinfection. Thus calves could still be exposed to infection several months after the removal of infected animals. The organisms in calf faeces died out more quickly than those in faeces from adult active carriers, suggesting that the risk from contaminated calf pens is of shorter duration than that from a loose-box that has housed infected yearlings or adults.

Calves can also acquire salmonella infection from milk. The milk of clinically affected cows commonly contains *Salm. dublin* during the febrile stage of the disease (Tulloch, 1939; John, 1946; Field, 1948; Gibson, 1958), but it appears that that of active carriers is seldom affected unless it has been subjected to faecal contamination (Standfuss, Wilken & Sörrensen, 1932; Rievel, 1933; Gibson, 1958; Harms, 1959). Grini (1949) attributed a series of outbreaks in Norway to contamination of skim milk returned from the dairies.

Although *Salm. dublin* has been isolated from many host species other than cattle the likelihood of these acting as a source of infection to calves appears slight compared with the grave risk of infection derived from infected adult cattle or calves.

An exception to this is that infected rats could possibly infect calves by contamination of food, bedding or utensils. Nordlund (1938) attributed an outbreak of *Salm. dublin* infection in lambs to this, and Field (1948) reported *Salm. dublin* infection in rats caught on or close to farms where cattle were infected. Gibson (1958) showed a correlation between the incidence of infection in rats (*Rattus norvegicus*) and cattle (see Table VII). This suggests that the acquisition of infection by rats might prolong the persistence of infection on a farm after the death or sale of infected cattle but that this prolongation would probably be of limited duration.

Infected rats might also carry salmonella bacteria from infected to uninfected premises, especially as Davies, Emlen and Stokes (1948) have reported that rats infected with salmonellae tend to wander more than healthy ones. This possibility would be increased if exhaustion of food supplies, or some other adverse change in environment, such as increased trapping, caused rats to migrate from one farm to another.

TABLE VII

THE RELATIONSHIP BETWEEN THE INCIDENCE OF *Salm. dublin* INFECTION IN RATS AND IN CATTLE

Classification of farm		Number of rats examined	Number from which *Salm. dublin* was isolated	
				per cent.
Positive	(i)	102	8	(8)
Recently positive	(ii)	49	3	(6)
Negative	(iii)	527	3	(0·6)

DEFINITIONS

(i) Farms on which there were calves or older cattle excreting *Salm. dublin*.

(ii) Farms on which such animals had been present during the previous six months.

(iii) Farms on which such animals were not known to have been present during the previous six months.

A second possible exception is that the degree of contamination produced by outbreaks of *Salm. dublin* infection in sheep, such as those described by Shearer (1957) and Watson (1960) might be comparable to that produced by bovine infection.

Salm. dublin infection occasionally occurs in the calves of self-contained herds in areas, such as East Anglia, in which the disease is virtually unknown in adult cattle. In the author's experience examination of such herds has always failed to show the presence of adult carriers. As mentioned above, such outbreaks could originate from an intermittent excretor of the organism or from a transient activation of a latent infection, but such animals are not easily identified. Other possibilities include the spread of infection from neighbouring farms—especially if purchased calves are present on these—and, more remotely, the introduction of infection by wild or domestic animals or birds or in purchased feeding-stuffs and fertilisers.

The presence of salmonellae in fish meals and animal by-products that are used in feeding-stuffs and fertilisers has attracted much interest during recent years. A wide range of serotypes has been isolated from many different products used in Britain, the

incidence of contamination being especially high in imported bones and bone products, hoof and horn products and Angola fish meal. (Report, 1959*a*). Elsewhere a similar range of serotypes has been isolated from foods of vegetable origin (Hauge & Bøvre, 1958; Grumbles & Flowers, 1961). It appears, however, that the serotypes isolated from feeding-stuffs and fertilisers rarely include *Salm. dublin* and that these products are therefore unlikely to act as a source of this infection in cattle. Thus *Salm. dublin* was not present among the 85 strains of 34 serotypes that Walker (1957) isolated from organic fertilisers, and was isolated only once from the 1,262 samples examined in the more comprehensive survey referred to above (Report, 1959*a*). The survey did not include dried milk products, which, as common constituents of the "milk substitutes" used in calf rearing, would have been relevant to this discussion.

Salm. typhimurium infection in self-contained herds

Salm. typhimurium infection in adult cattle resembles that with *Salm.dublin*. Recovered cases may continue to excrete the organism (Rasch & Lorenzen, 1935). The active carrier state can also arise from mild or subclinical infection (Lerche & Bartel, 1936) but probably does not last as long as in *Salm. dublin* infection (Report, 1959*b*.) Surveys at abattoirs in Britain have shown the presence of a small number of active carriers (Ritchie & Clayton, 1951; Report, 1955; Stewart, 1957) and of latent carriers (Field, 1949*a*).

Adult cattle thus constitute a likely source of infection in calves, but as *Salm. typhimurium* shows no host specificity a complete epidemiological investigation of an outbreak in calves may entail examination of other farm animals; poultry; dogs, cats and various pet animals; wild animals and birds and the farm personnel in addition to the adult cattle. This formidable task is lightened if swabs (Moore, 1948) are used to examine the drainage from, for example, a piggery, instead of sampling individual animals. Purchased feeding-stuffs and fertilisers and surface water and drainage from neighbouring premises should also be examined. Phage typing is invaluable for establishing whether the strains isolated could be epidemiologically related, although it may not be possible to decide which was the primary source of infection. (Phage typing is of limited value in the investigation of *Salm. dublin* infection because the majority of strains belong to a single type (Lilleengen, 1950; Smith, 1951)).

Reports of *Salm. typhimurium* infection occurring in a variety of species include those by Sternert (1938), who isolated it from the faeces of geese and ducks on premises where a bull had shown clinical infection, and Sellers and Sinclair (1953) who isolated the organism from cattle, pigs, fowls, ducks and sewage. All the isolates were of the same phage type but only the cattle had shown clinical symptoms. Müller (1957) stated that in Denmark *Salm. typhimurium* infection in calves is often traced to poultry. Klotz (1959) isolated *Salm. typhimurium* from ducks and calves and attributed an extensive outbreak in the latter to the addition of ducks' eggs to the milk.

Rats are commonly described as a likely source of *Salm. typhimurium* infection. Nordlund (1938) attributed an outbreak in guinea-pigs to infection introduced by wild rats and showed that experimentally infected rats could infect guinea-pigs by contamination of bedding. Salthe and Krumwiede (1924) and Jones and Wright (1936) attributed outbreaks of *Salm. typhimurium* infection in man to contamination of food with the excreta of infected rodents. Various workers, including Khalil (1938), Ludlam (1954) and Brown and Parker (1957) have isolated *Salm. typhimurium* and other serotypes from town rats, but fewer reports are available of the examination of farm rats. However, in the survey referred to above (Gibson, 1958) only one of 678 rats obtained from 64 farms in Carmarthenshire yielded *Salm. typhimurium*. One yielded *Salm. thompson* and 14 (2 per cent.) *Salm. dublin*. *Salm. typhimurium* infection was virtually absent in the cattle on the farms from which the rats were obtained and was not known to occur in other farm livestock. The results therefore suggest that *Salm. typhimurium* infection is not normally present in farm rats unless they have contact with some source of infection. Thus their part in the epidemiology of *Salm. typhimurium* infection appears to be a limited one, similar to that played in *Salm. dublin* infection.

Feeding-stuffs and organic fertilisers are a more likely source of *Salm. typhimurium* infection than of *Salm. dublin* since the organism is more commonly present in such material (Walker, 1957; Report, 1959*a*). Smith (1960) found that when pigs received food containing a variety of Salmonellae, the serotype most commonly recovered from the mesenteric lymph nodes was *Salm. typhimurium*, although this was probably present in the food in much smaller numbers than most of the other serotypes. A similar selective action probably occurs in calves.

Sewage commonly contains a variety of serotypes, including *Salm. typhimurium*, and has been regarded as a source of bovine salmonellosis by various workers including Kröger (1954) and Holz (1956). Other workers, including Ellemann (1959) and van Dorssen, van Vloten, Poelma and Zwart (1960) have recently reported a high incidence of *Salm. typhimurium* and other serotypes in gulls on the coasts of Holland, Germany and Denmark. It appears that these must be added to the list of possible vehicles of infection.

Infection with other serotypes in self-contained herds

If infection with one of the relatively host specific serotypes such as *Salm. pullorum* or *Salm. choleraesuis* occurs in calves the source of infection will be sought chiefly in the appropriate host species. However, most of the miscellaneous serotypes occurring in calves show no host specificity, and the remarks on *Salm. typhimurium* infection are therefore largely applicable. Examination of feeding-stuffs is especially desirable in such cases. Müller (1958) noted a close correspondence between the range of serotypes isolated from calves and from fish meal and meat and bone meal. Gray, Lewis and Gorrie (1958) made similar observations in adult cattle.

Infection in purchased calves

Many outbreaks of calfhood salmonellosis occur in calves purchased for rearing for beef. Often they are on premises where no older cattle are kept.

These infections could originate in the various ways described above but experience suggests that in most cases infection is introduced with the purchased calves.

Thus investigation by the author of 5 outbreaks of *Salm. typhimurium* infection in East Suffolk in the summer of 1960 showed that all 5 yielded phage type 1*a*, although in one outbreak type 1*a var.* 3 and *Salm. dublin* were also present. All 5 batches came from the same dealer. Two had passed through the local market but 3 had been delivered direct. Investigations on the farms showed no likely source of infection, leaving little doubt that the calves were infected before delivery.

Further evidence derives from a study, still in progress, of calves passing through a dealer's premises. The calves are chiefly from the West Country. Some are purchased direct from farms and others from markets. They are brought by lorry to the dealer's premises where rectal swabs are taken for laboratory examination.

Between July and October 1960 salmonellae were isolated from 12 (one per cent.) of 1,181 calves deriving from 7 (26 per cent.) of 27 batches. The isolates comprised 5 strains of *Salm. typhimurium* (four different phage types from 4 batches of calves); 3 of *Salm. dublin*, from 3 batches of calves; 3 of *Salm. agama*, all from the same batch, and 1 of *Salm. saint paul*. No salmonellae were isolated from a further 1,337 calves (23 batches) examined between October, 1960 and May, 1961. Again, this study provides clear evidence of the introduction of infection from external sources.

The calves handled by dealers come from many sources, including areas, such as those in South Wales and Somerset (Grunsell & Osborne, 1948), where *Salm. dublin* infection is known to be endemic in adult cattle. It appears that *Salm. dublin* infection is introduced chiefly by calves from these areas and spreads to other calves, of the same or subsequent consignments, in lairages and lorries. The various secondary aetiological factors discussed above undoubtedly aid this dissemination. *Salm. typhimurium* infection could be introduced either by calves or in the other ways discussed above.

Public Health Aspects

Salmp. typhimurium is one of the chief causes of food poisoning in man in Britain. Thus in 1959 it was responsible for 3,198 (41 per cent.) of the 7,846 reported incidents of food poisoning and for 61 per cent. of the 5,266 incidents for which the cause was found. Fifteen of the 27 fatal cases of food poisoning were due to this serotype (Report, 1960).

Salm. dublin can also cause food poisoning in man, and explosive outbreaks have been described by various workers including Conybeare and Thornton (1938), Tulloch (1939) and McCall (1953). It is, however, of only minor importance.

In addition to causing food poisoning *Salm. dublin* can give rise to meningitis and septicaemia in children (Smith, 1933), and occasionally to osteomyelitis (Miller, 1954) and localised abscess formations (Purnell, 1952; Davies, 1954). It is of interest to note that the first recognition of the organism as a separate serotype was based on strains isolated from cases of meningitis and septicaemia in man (White, 1930). However, even when incidents of this kind are included, the incidence of *Salm. dublin* infection in man remains low. Thus in 1959 only 36 (0.7 per cent.) of the 5,132 strains isolated from incidents of human salmonellosis were *Salm. dublin*, whereas 3,241 (63 per cent.) were *Salm. typhimurium* (Report, 1960).

Human salmonellosis can arise either from contact with live infected calves or from the presence of salmonellae in the carcases of calves killed for food.

Infected calves are a potential source of salmonellosis to farm personnel, their families, veterinarians and others, the likelihood of infection being greater with *Salm. typhimurium* than with other serotypes. Again, phage typing is invaluable in establishing epidemiological relationships.

The information available to Veterinary Investigation Centres suggests that *Salm. typhimurium* infection spreads from calves to man in about from 3 to 6 per cent. of the outbreaks diagnosed, but investigation by the author, in collaboration with local Medical Officers of Health, of 8 recent outbreaks in calves showed that human infection with the same phage type of *Salm. typhimurium* was present on 3 of the 8 farms. On one a 17-year-old cowman was a symptomless carrier, and on another a 12-month-old child. On the third a boy of 17 was ill for a week with vomiting and diarrhoea, while his 13-year-old sister was a symptomless carrier. These results suggest that the proportion of outbreaks that spread to man may be several times higher than is usually recognised.

During these investigations rectal swabs were taken from farm dogs on 6 of the 8 premises. *Salm. typhimurium* was isolated from 2, on separate premises, and *Salm. dublin* from a third, on the farm where this serotype was present in calves. This suggests that dogs may be of some importance in the transmission of infection from calves to man, and especially to young children.

Veterinary surgeons in practice can do much to reduce the risk of infection spreading to man by advising their clients on appropriate precautions. A rubber coat or apron should be kept for wearing in the sick bay and disinfected after use and care should be taken to wash and disinfect the hands after attending to sick calves. Young children are especially susceptible to salmonellosis and should never be allowed to fondle sick calves. Dogs should also be excluded. In view of the severity of *Salm. dublin* infection on those occasions when it does occur in man (Taylor, 1953) these precautions should be taken in every calf outbreak, whatever the serotype.

The possibility of human infection from salmonellae in the carcases of slaughtered animals was fully discussed by Buxton (1957*b*). The infection can

arise either directly from the carcase or indirectly, by the contamination of other carcases or other foodstuffs.

Calves that are ailing at the time of slaughter constitute a special danger (Zeinert, 1938; Pullinger, 1950) and it is deplorable that facilities for the bacteriological examination of such animals are so scanty. It is fortunate that most calves clear themselves of active infection long before they are slaughtered for beef, although, as stated above, the author suggests that some remain latently infected.

Diagnosis

In view of the variability of the clinical symptoms and of *post-mortem* findings it is rarely possible to offer a firm diagnosis without resort to bacteriological examination. Where possible, entire carcases should be submitted to the laboratory. If viscera are selected for submission they should include a portion of liver with the attached gall bladder and a length of small intestine with the mesenteric lymph nodes. When no carcases are available, rectal swabs should be taken from clinically affected calves. As stated above, excretion of the organism may be intermittent, and it is therefore advisable to sample 5 or 6 calves. When only a few calves are at risk, and especially when pneumonic or arthritic symptoms predominate, it may be necessary to take repeated samples, or to take blood samples for serological examination, before confirmation is obtained.

Treatment

Various drugs have been advocated for the treatment of calfhood salmonellosis, including sulphadiazole (Barron & Scott, 1949); phthalylsulphathiazole (Henning, 1953*b*), intravenous oxytetracycline* (Ben-David, 1953) and oral neomycin sulphate (Dickson, 1954).

Probably the drug most commonly used for treatment at the present time is furazolidone,† at an oral dosage rate of from 14 to 28 g. (½-1 oz.) of premix per day for calves of from 60 to 120 lb. bodyweight. This is given for from 3 to 5 days. These recommendations are based on the work of Henning (1954) and Frik (1959). Overdosage may produce symptoms of toxicity, namely, nervous disturbances, hyperaesthesia and inco-ordination, but these regress within a few days of cessation of treatment.

Chlortetracycline‡ is also widely used. Brennan and Laskey (1954) reported excellent results from oral dosage with 12 to 16 mg. per lb. bodyweight per day, given for 2 to 4 days. Bacitracin and streptomycin gave a poorer response and mortality remained at 50 per cent.

The use of chloramphenicol has also received favourable reports. Henning (1952) successfully treated an experimentally induced *Salm. dublin* infection with subcutaneous chloramphenicol at the rate of 2 g. thrice daily for 3 days. Howarth, Cordy and Bittle (1954), used chloramphenicol to treat a calf scour problem associated with infection with *Salm. bredeney*. They gave 500 mg. orally for 4 days, but suggested that in stubborn cases the dose could be increased to 1.0 or 1.5 g., or the drug given intravenously.

It must be emphasised that although most outbreaks show a favourable response to specific drug therapy general nursing measures are also most important. Sick calves should be kept warm and free from draughts and it may be necessary to hand feed the worst affected with milk, gruel and eggs. Lofty calf pens may need to be improved by improvising a false ceiling or a kennel type shelter. An infra-red lamp is commonly invaluable.

The modern emphasis on specific drug therapy has led to the neglect of general measures of this kind—often to the detriment of the calves.

The value of any treatment can be assessed only by the clinical response, since it appears that, as in man (Anon., 1959), drug therapy does not reduce the length of time for which the causal organism is excreted.

Preventive Measures

It is difficult to prevent the introduction of salmonellosis into rearing establishments that have to buy large numbers of calves.

Ideally, calves should be obtained from a local dairy herd known to be free from disease, but the demand for such calves invariably exceeds the supply. Moreover it is difficult to obtain them in convenient batches.

If local arrangements cannot be made calves should be obtained by as direct a route as possible, avoiding those that have been exposed in several markets or collecting centres. This, together with good standards of housing and husbandry will do much to prevent the occurrence of salmonellosis and, also, of *E. coli* infection. There may, however, still be occasions when it may seem advisable to prescribe prophylactic drug therapy, using furazolidone or a tetracycline, although this may encourage the establishment of drug-resistant strains. Blaxland (1960) reported that resistant strains can arise, and subsequently cause losses, when furazolidone is used prophylactically for salmonellosis in broiler chickens.

A number of workers, including Gribanov (1937); Pellissier, Trinquier and Troquereau (1948) and Henning (1953*b*) have advocated vaccination for the prevention of calfhood salmonellosis, and it seems that this might have some application in purchased calves in Britain.

Since so many outbreaks of *Salm. dublin* infection in calves in self-contained herds originate from active carriers among the older cattle it follows that the basic preventive measure in such herds is the identification and elimination of such carriers. In this author's opinion the examination of rectal swabs is sufficient for this, although serological examination of blood samples is useful on those ocasions when it is practicable.

The same approach should be made when infection with *Salm. typhimurium* or other serotypes occurs in a closed herd, except that here, as explained above, the examination should not be limited to the cattle population.

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* Terramycin.

† Neftin. The premix contains 4.4 per cent. of furazolidone.

‡ Aureomycin.

The measures suggested for use in individual herds are also applicable to the national herd in that a reduction in the number of adult cattle excreting *Salm. dublin* could be expected to be followed by a reduction in the number of outbreaks of *Salm. dublin* infection in calves, both within the endemic areas and elsewhere. Similar action against adult carriers of *Salm. typhimurium* would reduce what is probably the chief source of infection in calves as well as reducing one of the sources contributing to infection in man.

Field (1959) described a system of control measures in which clinical salmonellosis of adult cattle would be a notifiable disease, and faeces examinations made in herds in which clinical cases had been confirmed. Similar control measures have been suggested by Manninger (1939) and Beijers (1948). Clarenburg and Vink (1949) advocated similar action and described its application in one province of Holland.

The author suggests that in areas where the incidence of adult salmonellosis is high such control measures have much to commend them and would result in a lowered incidence of the calfhood disease elsewhere.

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2.—Studies of Human Salmonellosis in Relation to Infection in Animals

BY

N. S. GALBRAITH

**Epidemiological Research Laboratory,
Central Public Health Laboratory,
Colindale, London**

SUMMARY.—Human salmonellosis has increased in England and Wales in the past decade. The 3 main known sources of infection are meat, meat products, and bulk egg products. These materials have in common the fact they are produced in bulk and this is probably related to their high rates of contamination with salmonellae.

Water and milk are also produced in bulk for the community but strict measures of hygiene are imposed to prevent water-borne and milk-borne infections. Not until there is a higher standard of hygiene in the preparation of these other foodstuffs is there likely to be a reduction in human food poisoning.

To prevent faecal contamination of meat, improvements in abattoir practice are required. In addition veterinary measures designed to reduce the build-up of infection in animals before slaughter would be of value. Both from the veterinary and the medical points of view bacteriological control of animal feeding-stuffs seems desirable.

Lastly, knacker's dog meat may be a source of human salmonellosis and should be sterilised before sale.

THE salmonella group of organisms comprises over 600 serologically distinct types all of which are believed to cause disease in human beings, in animals, or in both (Taylor, 1960). Typhoid and paratyphoid fevers are specifically human diseases, although isolation of the causative organisms from animals has been reported on a few occasions (Buxton, 1957). These 2 diseases originate from human cases and carriers and are spread by water, shellfish, milk or food (Savage, 1942).

The diseases in human beings caused by other salmonellae are less severe. In this country, measured in absolute numbers, they kill more people each year than do typhoid and paratyphoid fevers combined (Anderson, 1960b). The sources of these organisms are animals of various species, infection being conveyed to human beings usually by the

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contamination of food with intestinal contents of animals. However, the chain of infection from animals to man is often long and devious and despite full investigation frequently remains obscure.

A number of studies in which I have taken part, together with veterinary and other medical workers, in an attempt to elucidate this chain of infection, form the basis of this paper.

Human Salmonellosis in England and Wales

The number of incidents* of human salmonellosis reported annually in England and Wales has increased during the last decade (Reports, 1950, 1951, 1954, 1955a, 1955b, 1956, 1957, 1958b, 1959b, 1960).

In 1949 there were 1,369 reported incidents and in 1959 5,132 (Table I). There is little doubt that some of this increase is spurious being due to better laboratory facilities, better reporting and greater interest in the disease, but in part it probably represents a true increase.

TABLE I
SALMONELLA INCIDENTS
ENGLAND AND WALES, 1949-59

Year	Number of incidents			
	Total all Serotypes	*S. typhi-murium*	*S. heidel-berg*	*S. saint-paul*
1949 ...	1,369	1,053	nil	2
1950 ...	2,021	1,593	nil	1
1951 ...	1,711	1,236	nil	3
1952 ...	2,142	1,604	nil	1
1953 ...	3,171	2,438	11	15
1954 ...	3,576	3,038	16	25
1955 ...	5,383	4,276	77	37
1956 ...	4,412	3,245	136	8
1957 ...	4,278	2,973	269	54
1958 ...	4,952	3,406	308	95
1959 ...	5,132	3,241	182	83

S. typhimurium is the commonest serotype affecting man in this country but does not account for all the increased incidence of salmonellosis. Some previously rare serotypes have become commoner and some entirely new serotypes have appeared. The number of reported incidents due to *S. typhimurium* rose from 1,053 in 1949 to 3,038 in 1954 but apart from the high figure of 4,276 in 1955 the number has since remained fairly steady (Table I). Among the previously rare or unknown serotypes that have increased in frequency may be mentioned *S. heidelberg* and *S. saint-paul* (Table I). There were 11 incidents due to *S. heidelberg* reported in 1953 and 182 in 1959, a more than ten-fold increase. There were 15 incidents due to *S. saint-paul* reported in 1953 and 83 in 1959, a more than five-fold increase. Thus, although the increase in salmonellosis prior to 1953 has been due mainly to *S. typhimurium*, more recently it has been due to other less common serotypes (Fig. 1).

The cause of these changes in the prevalence of different serotypes is not fully understood, but it has been noted that many of the uncommon serotypes isolated from human beings with increasing frequency since 1953 have been isolated also from imported animal feeding-stuffs (Walker, 1957; Reports, 1959a, 1961). Furthermore, Newell *et al.* (1959) have shown that contaminated animal feeding-stuffs may give rise to infection in animals and disease in human beings.

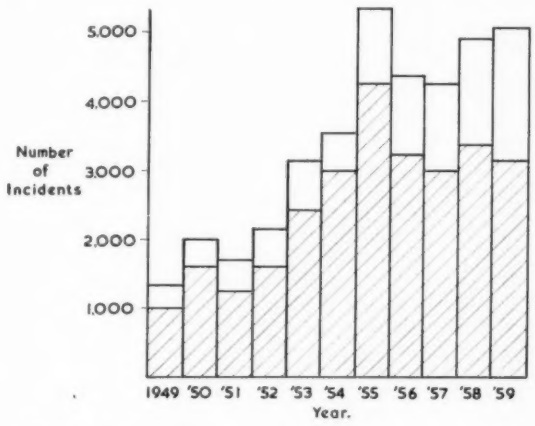

FIG. 1.—*Salmonella typhimurium* and other salmonella serotypes. Number of reported incidents. England and Wales 1949-59.

Not only has the prevalence of different salmonella serotypes in the human population altered in recent years, but the type of incident has changed. The proportion of general outbreaks, that is 2 or more related cases in different families, has decreased each year (Table II). One hundred and fifty-three (11.18 per cent.) of 1,369 incidents in 1949 were general outbreaks compared with 94 (1.83 per cent.) of 5,132 incidents in 1959. This change occurred at a time when human salmonellosis was receiving greater attention by the public health authorities.

TABLE II
GENERAL OUTBREAKS OF SALMONELLA INFECTION
ENGLAND AND WALES, 1949—59

Year	Number of general outbreaks	Total number of incidents
1949 ...	153 (11·18)	1,369
1950 ...	164 (8·11)	2,021
1951 ...	126 (7·36)	1,711
1952 ...	117 (5·46)	2,142
1953 ...	213 (6·72)	3,171
1954 ...	177 (4·95)	3,576
1955 ...	123 (2·28)	5,383
1956 ...	114 (2·58)	4,412
1957 ...	96 (2·24)	4,278
1958 ...	77 (1·55)	4,952
1959 ...	94 (1·83)	5,132

(Percentages in brackets).

* "Incident" means a sporadic case, a family outbreak or a general outbreak (Report, 1950).

The fall in the proportion of general outbreaks may be related to alterations in the distribution of food. In recent years there has been a change in the areas of distribution of food in this country. Small-scale food production with a local distribution has become less common than in the past and many foodstuffs, both home-produced and imported, are now distributed throughout large areas of the country. Thus, cases comprising an outbreak of food-borne disease may be scattered over a very wide area and therefore difficult to connect together. Another factor may be the improvement in hygiene of food factories, canteens and restaurants which in the past were the sources of local outbreaks.

Sources of Human Infection

In the Annual Reports on Food Poisoning of the Public Health Laboratory Service the vehicles of infection in general outbreaks and family outbreaks are recorded. Between 1949 and 1959 there were nearly 5,000 outbreaks of salmonella infection but in only 645 (13 per cent.) of these was the vehicle of infection identified with reasonable certainty. An analysis of the vehicles of infection in these 645 outbreaks is shown in Table III.

TABLE III
GENERAL OUTBREAKS AND FAMILY OUTBREAKS OF SALMONELLOSIS
VEHICLES OF INFECTION
ENGLAND AND WALES, 1949–59

Vehicle	*S. typhimurium*	Other salmonellae	Total
Meat and meat products	196 (41)	102 (66)	298 (47)
Eggs and egg products	154 (31)	18 (12)	172 (27)
Sweetmeats (trifles, custard etc.)	78 (15)	21 (14)	99 (15)
Other	64 (13)	12 (8)	76 (11)
Total	492 (100)	153 (100)	645 (100)

(Percentages in brackets)

Meat and meat products were the commonest vehicles of infection accounting for 47 per cent. of all outbreaks. Twenty-seven per cent. were due to eggs including egg products, 15 per cent. to sweetmeats and 11 per cent. to other vehicles. Forty-one per cent. of *S. typhimurium* outbreaks were caused by meat. Sixty-six per cent. of outbreaks due to other serotypes were caused by meat. The latter higher percentage may be indirectly associated with contaminated animal feeding-stuffs. These materials have been shown to be a source of many salmonella serotypes but among these *S. typhimurium* is uncommon.

Meat and meat products are known to be frequently contaminated with salmonellae. Hobbs and Wilson (1959) examined imported and home-produced raw meat in London and isolated salmonellae from 4.3 per cent. of samples of carcase meat and 10.3 per cent. of samples of boneless meat. In the United States of America, Galton, Lowery and Hardy (1954) found 23 per cent. of samples of fresh pork sausage and 12.5 per cent. of samples of smoked pork sausage to be contaminated. A lower figure of 2.5 per cent. was recently recorded in a study of sausages offered for retail sale in this country. Although these meats are subjected to cooking before consumption, organisms may be transferred to cooked products during preparation, or food-handlers may become infected and subsequently contaminate other foods. Furthermore, Miller and Ramsden (1955) showed that under certain circumstances salmonellae in the centre of pies might survive cooking, and Galbraith *et al.* (1961) found that salmonellae could be isolated from the centre of pork sausages after they had been cooked in lard at 162° C. for 5 minutes.

Egg and egg products are another common source of salmonella organisms. Duck eggs are frequently contaminated with salmonellae either in the yolk or on the shell. Hens' eggs are rarely contaminated. Bernstein (1952) did not isolate salmonellae in a survey of over 3,500 marketable eggs. Bulk egg products are, however, frequently contaminated (Report, 1958a) and have been shown to be the cause of human salmonellosis (Report, 1947) and paratyphoid fever (Newell *et al.*, 1955).

In 1953 an outbreak of typhoid fever and salmonellosis in Australia was traced to contaminated desiccated coconut (Wilson & Mackenzie, 1955) and recently, desiccated coconut imported into this country has been found to be contaminated with salmonellae including *S. paratyphi B* (Galbraith *et al.*, 1960; Anderson, 1960a).

Meat, particularly boneless meat and meat products, and bulk egg products are the main known sources of human salmonellosis in this country. There are, however, likely to be other materials, for example desiccated coconut, which may also prove to be important sources of human infection. Meat and meat products are the most important sources of infection which are produced in this country and the studies to be described are concerned with these materials.

An Outbreak of Human Salmonellosis Associated with Infection in Calves

Anderson *et al.* (1961) described an outbreak of 90 cases of infection with *S. typhimurium* phage-type 20a in south-east England which were associated with infection in calves (Fig. 2).

A high proportion of the initial cases were in orthodox Jews suggesting Kosher meat as a possible vehicle of infection. The main clue to the outbreak, however, was the isolation of *S. typhimurium* phage-type 20a from calves suffering from enteritis on a farm in Essex. It was found subsequently that in about three-fifths of the cases in the outbreak calf meat was the most probable vehicle of infection.

In most of the incidents, the calf meat came from animals purchased from a dealer near Oxford who had also supplied the calves which developed *S. typhimurium* phage-type 20a infection in Essex. The calves were purchased from 25 different markets, mainly in the west of England, and were sold either to farmers for rearing, or to abattoirs at Oxford,

London, Brighton and Salisbury. On most weekdays they were kept on the dealer's premises for less than 24 hours but for considerable longer periods over the week-end. At Oxford, London and Brighton abattoirs, slaughtering was carried out mainly on Sundays and Mondays and the calves

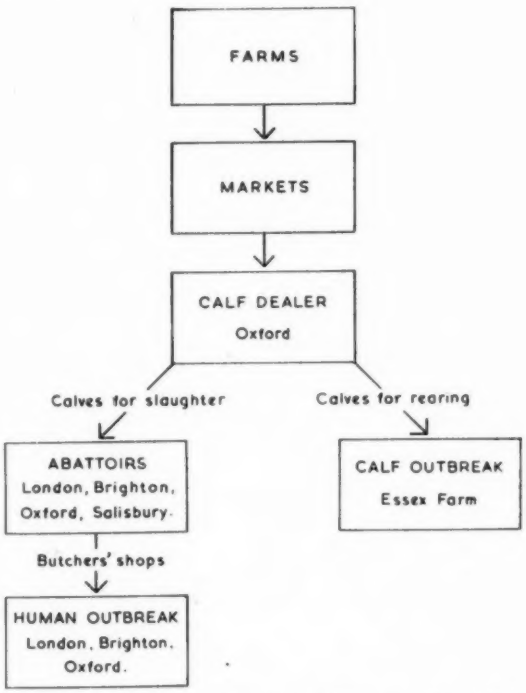

FIG. 2.—*Salmonella typhimurium* phage-type 20a. Diagram of the chain of infection.

were all held by the dealer from the preceding Wednesday, Thursday or Friday. In the London, Oxford and Brighton areas human cases of infection occurred. At Salisbury abattoir slaughtering was done on Thursdays only and these calves were purchased from markets on the previous day. No human cases occurred in the neighbourhood.

The dealer's premises consisted of a series of pens in which the calves were held awaiting delivery to farms or abattoirs. It was clear that cross-infection could occur in these pens, particularly when there was a large number of calves held together. The London consignment of calves was usually about 100 and these animals were accommodated in one large pen over the week-end. There was no illness and no deaths reported in calves held at the centre.

The calves were fed on dried milk by the dealer; salmonellae were not isolated from samples of this material. The water was not contaminated, nor were salmonellae isolated from hay and straw used to bed down the calves. One hundred and thirty-one specimens of material from the calf pens were examined and *S. typhimurium* phage-type 20a was isolated once from dust from a ledge on the wall of one pen. None of the specimens from the floor was positive, probaby because it was frequently sprayed with disinfectant. Rectal swabs of 544 calves arriving at the collecting centre on different days were examined and *S. typhimurium* phage-type 20a was isolated once. The market and farm of origin of this calf were investigated with negative results.

These facts suggested that the dealer's premises were not the origin of the *S. typhimurium* phage-type 20a infection but that the organism was probably introduced repeatedly by infected calves and then spread among the animals which were herded together for several days.

Three different markets in the west country were investigated, because it was thought that these were the most likely origins of the infected calves. Rectal swabs of 1,127 calves were collected and *S. typhimurium* of various phage-types was isolated from six (0.5 per cent.). *S. typhimurium* phage-type 20a was isolated once, but the calf concerned had come from a farm which had been stocked 3 months previously with calves from the Oxford dealer. There had been no illness in the calves on this farm but 3 out of 6 remaining calves were found to be excreting *S. typhimurium* phage-type 20a. Thus, although the origin of *S. typhimurium* phage-type 20a was not found, the market investigation did give an indication of the salmonella infection rate of calves in the area. On the farms it was probably less than 0.5 per cent.

Calves were examined at Salisbury abattoir and 2 London abattoirs, by taking rectal swabs after slaughter but before evisceration. At one London abattoir swabs of caecal contents were also collected. At Salisbury 120 rectal swabs were taken on 4 separate occasions but salmonellae were not isolated. At the London abattoir, however, salmonellae of various types were isolated from 74 (20.1 per cent.) of 369 rectal and caecal swabs. *S. typhimurium* phage-type 20a was isolated on 26 occasions but only from calves slaughtered on Sundays or Mondays. That is, from calves held at the dealer's premises for several days.

The build-up of infection in calves between the market and the abattoir was demonstrated by considering all types of salmonellae isolated (Table IV). In the markets the infection rate was 0.5 per cent.

TABLE IV

EXAMINATION OF RECTAL AND CAECAL SWABS OF CALVES AT TWO LONDON ABATTOIRS

Abattoir	Day of slaughter	Number of calves examined	Number positive and organism isolated	Percentage positive
A	Monday	133	12 *S. typhimurium* 20a 43 *S. typhimurium* 2c 1 *S. typhimurium* 2 2 *S. typhimurium* untypable 1 *S. dublin*	35·6
B	Sunday & Monday	72	14 *S. typhimurium* 20a	
A	Tuesday	156	1 *S. dublin*	0·6
B	Tuesday	8	nil	

In calves slaughtered in London on Tuesdays, that is, kept at the dealer's premises for a few hours only it was 0.6 per cent. However, in calves slaughtered in London on Sundays and Mondays which had been kept together for 2 to 5 days it was 35.6 per cent.

Investigations were carried out at one butcher's shop implicated in the outbreak, and it was found that *S. typhimurium* phage-type 20a reached the shop on the skin of the heads of the calves. These heads became contaminated with infected faeces when they were allowed to fall to the floor in the abattoir. The organism may have reached the butcher's shop by surface contamination with faeces of the carcase and liver but this was not demonstrated. There was no evidence that the calves were septicaemic at the time of slaughter and it did not appear that contamination of the interior of the meat was a likely mode of spread of the organism.

This outbreak demonstrates that human food poisoning due to *S. typhimurium* may be associated with symptomless infection in calves especially when the animals are kept together in large numbers for long periods before slaughter. The build-up of infection between the farm and the abattoir has been demonstrated also in pigs by Galton, Smith *et al.* (1954). McDonagh and Smith (1958) showed that cross-infection occurred among pigs kept in an abattoir lairage and found that human salmonella infections in the district were closely related to the abattoir findings. Singer and Brandly (1960) carried out a survey of horse-meat and found that the samples obtained from horses slaughtered in the first 3 days of the week were more frequently contaminated with salmonellae than those obtained from horses slaughtered on Thursdays and Fridays. They suggested that this might be due to cross-infection among horses kept together in the abattoir lairages over the week-end.

It is clear, therefore, that a build-up of salmonella infection may occur in animals herded together before slaughter and that this may be related to outbreaks of human food poisoning. It could doubtless be minimised by reducing the period of the animals' journey from the farm to the slaughterhall and by limiting the number of animals kept together at all stages of the journey.

The outbreak demonstrates the value of phage-typing of *S. typhimurium* in the epidemiology of this organism. Only by this means was it possible to connect together the widely scattered human incidents and to associate them with the oubreak of enteritis in calves.

Salmonella saint-paul Infection in England and Wales

Because this organism had become an increasingly common cause of human food poisoning in the past few years (Table I), a detailed study of the human incidents was made in 1959 (Galbraith *et al.*, 1961).

Early in 1959 two incidents occurred in south-west England. In both of them persons had received supplies of pork products from a single local abattoir. By means of the sewer swab technique described by Moore (1948) *S. saint-paul* was isolated from the sewage effluent of this abattoir, and subsequently infection was demonstrated in pigs and cattle. Routine investigation at another abattoir led to the discovery of *S. saint-paul* infection also in pigs.

Forty-nine human incidents were investigated and 15 were found to have an association with the products of 1 of these 2 abattoirs. In 14 of the incidents the meat concerned was either pork sausages or faggots. *S. saint-paul* was isolated twice from 32 samples of pork sausages.

At one of the abattoirs it was the practice to purchase animals suffering from disease or injury because they were cheap. *S. saint-paul* was isolated from a cow suffering from enteritis at the time of slaughter and the meat from this animal, being normal on inspection, was passed as fit for human consumption. The farm of origin of this cow was investigated with negative results, but it was ascertained that the animal had passed through the premises of 2 dealers before reaching the abattoir where it is probable that the infection was acquired. *S. saint-paul* was isolated from 7 other cows and 13 pigs in the abattoir all of which were free from symptoms.

Investigation of 2 dealers' premises, a market and farms were all negative and the source of the abattoir infections was not found.

During 1959 the Central Veterinary Laboratory reported 10 isolations of *S. saint-paul* and all these isolations were from outbreaks of disease in cattle or poultry in the southern half of England and Wales. This geographical distribution corresponded closely to the distribution of human incidents in both 1958 and 1959.

One of the isolations was from chicks suffering from enteritis on a west of England farm. Six out of 150 birds died between 2 and 4 weeks after purchase as day-old chicks. The chicks remained infected and, when at the age of 28 weeks they were slaughtered, *S. saint-paul* was isolated from cloacal swabs of 5 (3.6 per cent.) of 140 birds.

The origin of the infection was not determined, but it was thought to be a contaminated poultry meal in use on the farm. *S. saint-paul* was not isolated from this meal although it contained other salmonella serotypes. The chief protein constituent of this meal was meat meal imported from America, a country where *S. saint-paul* infection is known to be widespread in animals (Bruner, 1956). This American meat meal, which was heavily contaminated with salmonellae, had been imported by one large firm and used in their compound feeding-stuffs since early 1958 but only at their south of England factories. Thus, the use of this material corresponded geographically and in time to the occurrence of human and animal *S. saint-paul* infection in the south of England.

Although the chain of infection was not fully elucidated in this study, it was apparent that in 1 abattoir the organism was being brought in by sick animals. The practice of killing sick animals in abattoirs handling meat for human consumption is obviously undesirable and should be prohibited.

Animal and Human Infection with *Salmonella heidelberg*

S. heidelberg was first isolated from human beings in this country in 1953 since when it has increased in frequency becoming in 1958 the commonest salmonella next to *S. typhimurium* (Table I). On several occasions pork products have been suspected as the source of the infection but the ultimate origin of the organism has remained obscure.

In December, 1959, an outbreak of *S. heidelberg* infection was reported in calves on a farm in Hampshire where the farmer had purchased calves at irregular intervals over a period of 3 months from one dealer. The precise origins of the calves were not known but the majority had been purchased in a large west Sussex market and delivered direct to the farm. On investigation it seemed probable that the infection was brought into the farm by the calves from this market.

In the last week of May, 1960, a family outbreak of *S. heidelberg* occurred in the same west Sussex market town and a sporadic case occurred in an adjacent town about 15 miles away. *S. heidelberg* infection had not previously been reported in the area and it seemed likely, therefore, that the 2 human incidents were associated with one another and possibly related to the calf outbreak that had occurred 5 months before.

Investigation of the 2 incidents did not reveal any obvious vehicle of infection and both the households concerned had consumed a variety of meats, although these did not include veal. The meat was mainly English and was purchased from 2 local butchers both of whom obtained some supplies from the same abattoir. This abattoir received animals from the west Sussex market already mentioned as the probable origin of the calves infected with *S. heidelberg*. Thus the market was a common factor between the 2 human incidents and the outbreak of infection in calves.

At the market there was little chance of cross-infection between calves and other animals, since they were kept some distance apart. However, calves frequently arrived at the market in vans carrying pigs also, so that cross-infection might easily have taken place. Both calves and pigs were, therefore, investigated. The results are recorded in Table V. Rectal swabs of 70 calves were collected on one day and 350 specimens of pig faeces on 5 different days. Over the same period sewer swabs were collected from the abattoir (Table V).

S. heidelberg was isolated 5 times on 3 days from pig faeces at the market. Three of the specimens collected on 3 separate days were from pens occupied by pigs from the same farm, and the organism was subsequently isolated at this farm. Two specimens came from nearby pens occupied by pigs from 2 other farms. Subsequent investigation at the farms, however, was negative and it is probable that these specimens were cross-contaminated in the market. *S. heidelberg* was not isolated from the abattoir sewer swabs. However, the isolation of the rare serotype *S. kiambu* from pig faeces in the market and 3 times from the abattoir sewer swabs suggests that salmonellae reached the abattoir from the market.

At the pig farm supplying the infected pigs *S. heidelberg* was isolated from pig faeces, mouse faeces and the sediment from the drain in the shed which housed the pigs for the last few weeks before they were sold. Specimens from sows and younger pigs and poultry on the farm were negative on 3 separate occasions.

TABLE V

SALMONELLA ISOLATIONS AT A WEST SUSSEX MARKET AND ABATTOIR. JUNE TO NOVEMBER, 1960.

Date	Market				Abattoir
	Faeces and rectal swabs				Sewer swabs
	Specimen and number		Salmonellae isolated		Salmonellae isolated
29. 6.60	Calves rectal swabs	70	nil		—
	Pig faeces	48	heidelberg	1	—
6. 7.60	Pig faeces	62	heidelberg	2	—
			california	1	—
7. 7.60	—		—		nil
15. 7.60	—		—		nil
20. 7.60	Pig faeces	54	kiambu	6	—
			derby	1	—
21. 7.60	—		—		nil
28. 7.60	—		—		nil
4. 8.60	—		—		nil
10. 8.60	Pig faeces	60	heidelberg	2	—
11. 8.60	—		—		livingstone & kiambu
18. 8.60	—		—		nil
24. 8.60	—		—		nil
31. 8.60	Pig faeces	48	nil		typhimurium
7. 9.60	—		—		kiambu
15. 9.60	—		—		typhimurium
21. 9.60	—		—		bovis-morbificans
28. 9.60	—		—		nil
6.10.60	—		—		nil
13.10.60	Pig faeces	82	nil		nil
20.10.60	—		—		bovis-morbificans & kiambu
3.11.60	—		—		nil

The only possibly significant difference that was apparent between the shed from which the positive specimens were obtained and the other sheds on the farm was the type of animal feeding-stuff in use. In the contaminated shed only, a meal made up by a local miller was used. This meal contained a nationally distributed protein concentrate, locally grown wheat and barley and South American maize.

At the local mill salmonellae were not isolated from 17 specimens of dust, floor sweepings and mouse faeces, but from 45 samples of the protein concentrate *S. senftenberg* was isolated once. The manufacturer of the concentrate provided samples of its ingredients and salmonellae were isolated 7 times from 42 samples of meat and bone meal—*S. senftenberg* 5 times, *S. typhimurium* once and *S. kentucky* and *S. hillsborough* once from the same specimen. Thirty samples of fish meal were negative. *S. heidelberg* was not isolated from these materials.

This study demonstrates the existence of a probable chain of infection from a pig farm to 2 human

incidents which only came to light by following the clue given by an outbreak of infection in calves. The source of the infection on the pig farm was not determined, but was probably contaminated animal feeding-stuffs.

On epidemiological grounds both *S. saint-paul* and *S. heidelberg* infections in this country probably originated from imported animal feeding-stuffs. It is desirable, therefore, from the medical as well as the veterinary viewpoint, that there should be some bacteriological control of these materials. In this way manufacturers could avoid buying from heavily contaminated sources.

Human Infection Associated with Dog Meat

During a study of human and animal infection with *S. typhimurium* phage-type 1a var. 2 in 1959, a possible association between a human case and contaminated dog meat was demonstrated.

A child of 2 years fell ill with *S. typhimurium* phage-type 1a var. 2 infection on September 4th. The parents and baby aged 6 weeks remained well and when examined their stools were negative. The family kept a dog which was fed on raw meat obtained from a local knacker's yard but unfortunately the dog was not examined until nearly 8 weeks after the child's illness, and at this time the faeces were negative.

The meat sold from the knacker's yard was derived from animals slaughtered because of disease or injury or from carcases of animals that had died on local farms. In the week that the child fell ill most of the dog meat had come from 5 calves slaughtered on August 31st because they were suffering from enteritis.

The farm of origin of these calves had previously been investigated by the Central Veterinary Laboratory on account of illness and deaths among calves and *S. typhimurium* phage-type 1a var. 2 had been isolated. The isolation of the same organism from the source of the dog meat and from the human case suggests that the two were associated. The fact that *S. typhimurium* phage-type 1a var. 2 was rare—only 30 human incidents were reported in England and Wales between August and December, 1959—strengthens the possibility of this association.

The preparation of the dog meat is usually carried out by the housewife in the kitchen and she may readily contaminate her hands, the draining board, sink, knives and utensils and transfer the infection to human food. A child of 2 years who may fondle the dog and play with the feeding bowls may easily become infected.

Cruickshank and Smith (1949) in a survey in London found 1 per cent. of 500 dogs to be excreting salmonellae in their faeces. A considerably higher incidence of up to 36 per cent. was found among kennel dogs in the United States of America (Buxton, 1955) and it has been suggested that this was due to contaminated pet foods containing egg or meat (Kintner, 1949). Galton *et al.* (1955) for example found 26.5 per cent. of dehydrated dog meals to be contaminated with salmonellae.

Infection in dogs is a potential source of human salmonellosis but, as Buxton (1955) points out, this is unlikely to be of great importance unless the animal is suffering from clinical disease. The chain of infection described suggests that the dog meat rather than the dogs themselves are the source of human infection. Clearly the practice of allowing raw knacker's meat to enter a household is undesirable; it should be sterilised before leaving the knacker's yard.

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THE SPEAKER'S INTRODUCTION

The Chairman, Professor R. Lovell, said he would like to quote some remarks of the late Sir William Savage, who some people thought was a great friend of the veterinary profession, and others thought otherwise. His death recently passed unnoticed in the veterinary press, but Sir William Savage had a great deal to do with salmonellosis in the early days. With Mr. P. Bruce White he wrote a report entitled "Food Poisoning: A Study of 100 Recent Outbreaks," and the following was a quotation from that report:—

"Nearly nine-tenths of food poisoning outbreaks are due to organisms of the *Salmonella* (or Gaertner) group of bacteria, and although much successful work has been done in the identification and classification of these organisms and in tracing the causes of particular outbreaks of poisoning, we have very little knowledge of the paths, whether through animal infections or otherwise, by which these organisms have found their way originally into the food to which their subsequent ill-effects may have been traced. . . . It may be added, in relation to this question of the better study of the causation of food poisoning, that progress on that side of the inquiry in which it was desired to deal effectively with the paths of infection through domestic or agricultural animals has halted, in spite of much effort, for want of better facilities in this country for systematic studies of comparative pathology, but it is hoped that in the early future the work can be extended successfully in this direction."

The Chairman said he often thought of that quotation when he considered the progress which had been made in the knowledge of salmonellosis infection in man and animals. Some of the progress which had been made would be the subject of this symposium.

Dr. E. A. Gibson said that his chief aim in the paper was to attempt to correlate the existing information about the disease, putting special emphasis on its causation and epidemiology. He had felt that to be necessary because of the various misconceptions that existed, and the faulty generalisations that were made about the disease.

The source of infection was likely to vary according to the kind of infection with which one was dealing, whether *Salm. dublin* or *typhimurium* or one of the miscellaneous serotypes. He hoped to be forgiven for referring to them as "miscellaneous," but it would probably be agreed that although the study of these serotypes had provided extremely useful information about the epidemiology of salmonellosis and the pathways that infection took between the farm animal, the slaughterhouse and the retail butcher's shop, from the practical veterinary point of view those serotypes were of minor importance. Thus the figures quoted in Table I of the paper showed that the more important serotypes, *dublin* and *typhimurium*, between them accounted for 96 or 97 per cent. of the salmonellae isolated from calves.

The source of infection was also likely to vary according to the kind of farm on which it occurred, according to the geographical locality—in other words, whether it was an area in which *dublin* infection was established and endemic in the adult cattle—and also according to the type of enterprise carried on on the farm, especially whether purchased calves played any part in the livestock enterprise. He would offer some details on those points later, but for the present he wished to say something about the position of salmonella infection in adult cattle. That might seem to be exceeding his terms of reference, but he thought it necessary if only because carrier adults formed the chief reservoir of *Salm. dublin* infection in calves, while adult carriers of *typhimurium* were also one of the various important sources of *typhimurium* infection in calves.

The importance of the adult was in keeping with one of the more noteworthy facts about *dublin* infection in cattle, namely, that the adult animal which recovered from a clinical attack of *dublin* infection invariably continued to excrete the organism in its faeces for a number of years, if not for the rest of its life. That was in marked contrast to the position in calves, where one found that the calf invariably ceased to excrete the organism within a few weeks of clinical recovery. The position with regard to *typhimurium* infection seemed to be similar, except that persistence of excretion by the adult appeared to be shorter than in the case of *dublin* infection. The importance of the adult animal was also in keeping with the fact that premises which became contaminated with the faeces of adult carrier animals appeared to remain infective for longer than those contaminated with the faeces of infected calves.

His impression was that infection of adult cattle with *typhimurium* occurred sporadically throughout Great Britain and probably throughout Europe. That was in keeping with the fact that the organism showed no host specificity. In other words, it represented a criss-cross of cross infection between cattle and the many other host species that could be infected with *typhimurium*. He appreciated that it might be necessary to revise that opinion when more was known about the phage types of *typhimurium* and their distribution among different host species. Knowledge on that point was still comparatively limited. It had been found that certain phage types seemed to be predominant in certain host species. One thought of type 2c occurring in poultry, but it was too early to say whether this distribution was a matter of historical accident.

It seemed that superimposed on this background of sporadic *typhimurium* infection there were certain areas in which *Salm. dublin* infection was established and endemic in adult cattle to the extent that in carrying out surveys one found an active carrier rate of about 1 per cent. That incidence would seem to be some 10 or 20 times greater than the background incidence of *typhimurium* infection. Endemic areas of that kind had been described in Wales, in coastal areas of Germany, in certain parts of Denmark and in Ireland. In this country the pioneer work of Mr. Field had shown the existence of an area of that type in Carmarthenshire in South Wales. Grunsell and Osborne also showed a similar concentration of *dublin* infection in Somerset. It seemed that in the endemic areas there was a tendency for pastures to be of a rough, wet type—the type of country which one associated with liver fluke infestation. There was also a tendency for cattle to be dependent on streams, dykes or ditches for their drinking water. In the endemic areas one found that from time to time the organism gained access to the milk supply, either because of active excretion of the organism by a clinically affected cow or, more commonly, by contamination of the milk with infected faeces. When that occurred the infection might produce a short outbreak of food poisoning in man, characterised by sickness and diarrhoea. It was the investigation of that type of outbreak that first disclosed the presence of salmonella infection in adult cattle in this country. The first report of that kind seemed to refer to an outbreak in Newcastle in 1910, 20 years before the first reference in the veterinary literature to the disease in adults.

In the endemic areas *Salm. dublin* infection of calves invariably originated from infected adult cattle. In other words, if one investigated an outbreak of *dublin* infection in calves in such an area, one invariably found either the presence of active carriers among the adult herd, or else a history of a recent fatal clinical case. Theoretically, of course, calves could become infected by contact with a variety of other host species which might, from time to time, become infected with *Salm. dublin*, but he suggested that the risk of that occurring was small compared with the very real risk of infection from carrier adult cattle.

One exception which could be made applied to the farm rat. The habits of the rat obviously gave it opportunities

to contaminate foodstuffs used for feeding calves, and rats thus had more intimate contact with calves than had most other species. His own investigations had suggested that the rats themselves became infected by contact with infected cattle, and that if the carrier cattle were disposed of the infection in the rats would die away within a comparatively short time.

Occasionally, of course, *dublin* infection occurred in calves in self-contained herds outside the endemic areas. Thus it occurred in parts of the country, such as East Anglia, where the clinical disease in adult cattle was rare or quite absent. In the paper he had pointed out that in his experience investigations of that type of outbreak had always failed to show the presence of carriers among the adult cattle. Admittedly that statement was based on a limited number of investigations. However, two days after posting his paper containing that statement he had investigated a herd in which *dublin* infection had occurred in calves for the past two years. Rectal swabs were taken from the milking herd and *dublin* was isolated from 3 of the 60 cows. It was, therefore, necessary to modify the statement; although he would still say that it was most unusual to find carrier adult cattle outside those areas in which the clinical disease was recognised in adults. The outbreaks which occurred in that kind of herd might be explained by the presence of cows which only intermittently excreted the organism or which showed a transient excretion of the organism when some stress condition stimulated a latent infection. In that kind of outbreak one should also examine foodstuffs and fertilisers.

The position was different when one considered outbreaks of *typhimurium* in calves in self-contained herds. One still had to consider the adult herd as a possible source of infection, but, because of the complete lack of host specifi ity of the organism, one must also consider every other kind of livestock with which the calves had contact. One must also pay more serious attention to the feeding-stuffs and fertilisers, because they were more likely to contain *typhimurium* than *dublin*.

Rats were often thought of as likely sources of *typhimurium* infection. That was encouraged by the name of the organism. It was true that *typhimurium* could be isolated from town rats, rats caught in sewers, and so on, but experience suggested that that might not apply to farm rats. Thus a survey which he had made in South Wales some years ago showed almost no infection with *typhimurium*. It would seem that rats were unlikely to act as a source of infection to calves unless they had been in contact with infected cattle or other animals and had acquired infection from them.

As far as the occurrence of other serotypes in self-contained herds was concerned, he had little to add to what he had indicated in the paper except to say that the position was similar to that of *typhimurium*. Dr. Galbraith had provided some classical examples of how such outbreaks should be investigated.

So far all his remarks had referred to self-contained herds, but the position in East Anglia was that most of the salmonella infection occurred in purchased calves, often kept on premises where there were no adult cattle to act as sources of infection. In that type of outbreak it was again found that *Salm. dublin* was the predominant serotype, closely followed by *typhimurium*, and that other serotypes were comparatively rare. There was no doubt that in that kind of outbreak the infection was nearly always introduced in the purchased calves. He had given two points of evidence of that in the paper. One referred to a series of five outbreaks of *typhimurium* infection in which the evidence indicated quite conclusively that the infection had been introduced with the dealer's calves. The other referred to a survey of calves passing through a dealer's premises in which a variety of salmonella serotypes had been found. The paper mentioned that the first thousand or so samples, taken between July and October last year, had shown a 1 per cent. incidence of salmonella infection, but that the next 1,500 or so samples, taken from October to May, had given negative results. It might be of interest to add that no further isolations were made from the dealer's calves until the end of July this year, but that since then they had again yielded a variety of serotypes.

In his view there was no doubt that the *dublin* infection found in these calves originated, either directly or indirectly, from adult carrier cattle. This infection, of course, had ample opportunity to build up in markets, lorries and lairages. During that process the calves would also be exposed to cold, nutritional changes or abuse, and in that way would be far more susceptible to any salmonella infection they encountered than would a more normally kept calf.

Typhimurium infection in dealers' calves could, of course, originated from a variety of sources including the adult carrier cow.

Turning to the public health aspect, he said that because *Salm. dublin* was predominantly a cattle organism, *dublin* infection lent itself to control measures much more readily than did *typhimurium* infection. That was, in a sense, unfortunate, because *typhimurium* infection was far and away more important in man than *dublin* infection, although when *dublin* infection did occur it could produce quite lively outbreaks of food poisoning and could be more invasive and more fatal than many other serotypes.

Dr. Galbraith had given details of the various pathways by which infection could be carried from calves through butchers' premises to the retail shop and so to the consumer. He was very impressed by the finding that the organisms could be isolated from the heads of calves where the head had fallen onto the slaughterhouse floor and had become contaminated with faeces.

One gained the impression from the literature that a more direct spread of infection, from the infected calf to man, was somewhat unusual. That impression was strengthened by the figures given in the routine monthly returns of the Veterinary Investigation Service, where one saw that human infection was known to occur in some 3 or 6 per cent. of outbreaks of salmonella infection in calves. His limited experience suggested that that figure could be much higher if one went out and looked for human infection. He had done that in 8 outbreaks and had found human infection in 3 of them. That represented 4 infected persons, 1 of whom suffered a severe clinical attack of *typhimurium* infection. He had also mentioned that he had found farm dogs to be infected in 3 of 6 outbreaks. One had the impression that farmers' children were exposed to a double hazard, first from father, who bounced the baby on his knee and then washed his hands, and also from the farm dog.

Earlier he was perhaps critical about some of the generalisations which were offered about the source of infection in calves, and he realised that he might himself have offended by making equally sweeping generalisations in his paper about the similarity of the clinical disease produced by different serotypes and the pathogenesis of the disease produced, but he hoped to learn much about that from the ensuing discussion.

Dr. N. S. Galbraith said he was a newcomer to the subject of salmonellosis, and during the past 2½ years had worked at the Central Public Health Laboratory, Colindale, taking part in field investigations of human salmonella infections. A number of those investigations had revealed an association with animal infection. Before describing the investigations it might be of interest to see some recent statistics of human salmonellosis in England and Wales.

(Dr. Galbraith then showed a series of slides to illustrate his paper.)

The Opener

Dr. A. Buxton suggested that the greatest value was derived from the papers if they were considered together, because they showed a cycle of events which went on in man and in animals. They showed the difficulties experienced in controlling infection in animals on the farm, the routes by which infection could go from the animal to man, and the difficulties experienced in this country in preventing or reducing human infection derived from animal sources.

The most important factor which the papers set out was the difficulty in preventing and controlling infection. Both authors had discussed that and had put forward most useful suggestions, and he desired to discuss the control and prevention of salmonellosis in animals particularly from the public health point of view, because that should be of the greatest value at the present time.

There was still much that could be done in this country towards that end. The matter could be discussed under 3 headings: first, animal infection on the farm, second, animal infection in the slaughterhouse, and third, infection related to the preparation and distribution of human foodstuffs.

As regards infection of animals on the farm, Dr. Gibson had given a most comprehensive account of salmonella in cattle. It should be borne in mind that not only in cattle but in other animal species the picture of salmonellosis was always changing, and there was now salmonella in calves. The information on the distribution and incidence of salmonellosis in young calves was of great interest and importance, and one point of interest would be to learn whether the techniques and materials used and examined by different V.I.O. centres were the same. In other words, were all the results exactly comparable?

Dr. Gibson dealt in detail with the predisposing factors of salmonellosis in animals and it was a most important matter which again was changing, and one was now confronted with the possibility of feeding animals with contaminated foodstuffs. It had already been suggested that some bacteriological control should be instituted to ensure that the ingredients of foodstuffs, some of which might be imported into this country—certainly fertilisers which might be imported—were controlled by bacteriological means. Dr. Buxton also suggested that some of those ingredients should be heat treated before being incorporated in foodstuffs. It was known that there was a potential risk of infection, and it would seem that it would be a wise precaution.

There was the constant problem which again had been raised by Dr. Gibson of detecting symptomless carrier animals. In his paper he showed some graphs which illustrated the production of antibodies by animals which were infected, and those graphs demonstrated one of the problems. It would be noticed that in all cases the animals concerned showed symptoms several days before they produced detectable bacterial agglutinins in serum which would be of diagnostic value. That problem was recognised, and that was why it was essential to repeat testing when looking for infected animals. One wondered whether, under certain conditions, a form of indirect haemagglutination test might not be of value, that is to say, a test where normal healthy blood cells were used which had been coated on the outside with a bacterial antigen, and that was used as the antigen for the haemagglutination test. This technique had been tested experimentally for the detection of human typhoid infection, for *Salm. typhimurium* infection in poultry, and in Liverpool they had used this method for the detection of *Salm. gallinarum* infection in chickens. This test enabled recent infection to be detected several days earlier than it would be by the conventional bacterial agglutination test. In advocating the indirect haemagglutination test, Dr. Buxton stressed that adequate laboratory facilities must be available and that some knowledge of the average herd titres in the district was necessary to assay the results accurately. The test itself could be carried out rapidly and might be of particular value, in conjunction with bacterial examination of faecal samples, for eradicating infection in a closed herd.

As regards prevention and control on the farm, Dr. Gibson mentioned various factors. For example, there was the local purchase of calves. That would get over the strain of calves travelling long distances, being mixed up in dealers' yards, and so on. It would be of interest to hear the views of the authors on the practicality of that matter. One would have thought that the local purchase of calves would only concern a very small portion of the market.

One other point in connexion with prevention and control was that Dr. Gibson suggested that possibly vaccination had a part to play in the control of infection in calves. One gathered from his paper that he was referring to the question of calves being purchased and sent long distances, and was also referring to *Salmonella typhimurium* infection. It would be of interest if he expanded a little on that. It might well be that vaccination had a part to play. It had not always proved beneficial in the past, particularly in other countries, and one wondered whether, in young calves which had undergone the stress of travel, one found the best material for vaccination and getting the strongest possible immunity.

Secondly, there was the question of the prevention and control in relation to slaughterhouses. Dr. Galbraith had clearly put forward the important part which meat products played in causing human outbreaks of infection. It was known without doubt that a proportion—and probably the largest proportion—of those outbreaks were derived from meat and meat products, and that many of those infections came from animals themselves at the time of slaughter or beforehand. There was the cycle of events from infection on the farm to human infection, and it seemed that with the high number of incidents which occurred annually it was of importance to try to break into that cycle of events and perhaps reduce the amount of human infection. It would seem that one way to do that would be to ensure, for example, that all animals sent for emergency slaughter were subjected to some sort of bacteriological examination. That was done in other countries with considerable success. It was realised that in some cases it was done in this country, but it could be done or should be done to a much wider extent in view of the incidence of salmonellosis which was known to exist in animals, and the incidence of food poisoning in man. It was realised that it would not be possible to do it on an extensive scale immediately, but the time had come to look forward and to see if adequate facilities could not be provided together with personnel for carrying that out on a wider scale.

Finally, he had a question to ask Dr. Galbraith which might be difficult to answer. It had been seen that human food poisoning from meat and meat products was probably derived from animals to a very great extent. There had been one or two surveys on the incidence of the carrier rate of salmonella in man, which had put the figures at somewhere about 2.5 per thousand head of population. That was one point. Another point was that it seemed if one were experiencing a considerable amount of infected foodstuffs, those who were engaged in the food trades and industries should be more likely to pick up infection than those employed in some other industries. It would be interesting if Dr. Galbraith could suggest to what extent those large numbers of human food poisoning cases which occurred every year might be derived from a human source as compared with an animal source.

The General Discussion

In reply to a question from the body of the hall, **Dr. Galbraith** agreed that it was a dangerous practice to sell raw meat in the same butcher's shop where cooked meat was also being sold. A number of firms have separate raw meat and cooked meat counters as well as separate staff, and this should be a universal practice.

Mr. W. H. Parker (Thirsk) said that Dr. Galbraith submitted his percentages based simply on the actual cases which had been traced back to animal contamination, and as a result of those percentages the impression was gained that a great deal of *typhimurium* was clearly correlated to outbreaks in animals. If, however, the tables in the paper were re-examined, it was found that over the years set out some 35,000 to 40,000 outbreaks occurred, but in point of fact he only traced less than 500 to animal products. In other words it was somewhere about 1 per cent., and one was left with 99 per cent. *typhimurium* outbreaks unexplained. It seemed that the point might have some bearing on outbreaks of salmonellosis in animals, where workers agreed that stress factors were often a vital point rather than the source of the organism. Again, where outbreaks of salmonellosis in calves were encountered it was easy to trace the stress factor, but the most common cause was the passing of calves through the market with all the appalling conditions suffered by them. He had also seen outbreaks in calves where sheer bad management was the factor.

If there were only 1 per cent. of *typhimurium* which could be traced back to animals, whereas it was possible to trace back a higher percentage of *heidelberg* and *saintpaul*, it meant that it was another case of obsession with the bacteriological approach, and he suggested that in investigating salmonellosis in the human it was necessary

to think more of the stress factor. It might be that a large part of the 99 per cent. could be explained more on the basis that the organism was available and that the infection occurring in the human was due to stress factors much more than to the actual danger of the bug turning up.

Dr. Galbraith referred to the build-up of infection in animals retained for slaughter, and there might be in that a very rapid effect of a stress factor. The animals came into the abattoir, no doubt some of them carrying the bug; but the build-up occurred because of the bad conditions in which they were herded. Workers in Bradford claimed that they found salmonella in pig meat after slaughter, which was in direct contradiction to the experience in the V.I.O. centre, where salmonellosis was rarely found when carrying out *post-mortem* examinations on pigs.

Dr. Galbraith, in reply, said he pointed out in Table III of his paper that the 645 outbreaks of human salmonellosis constituted 13 per cent. of all outbreaks between 1949 and 1959 and he agreed that the source of infection was found in only a very small proportion of the total number of incidents.

With regard to the "stress factor" in human beings, he did not feel that "stress" was related to infection by an organism, although the "stress" might trigger off the development of symptoms.

With reference to the relationship of human incidents to pork more commonly than to veal; this was difficult to explain, but it might be due to the fact that pork was used much more frequently in manufactured meats compared with veal.

Mr. F. P. Lawton (Manchester) said that Dr. Galbraith suggested that the Meat (Staining and Sterilisation) Regulations could be made more comprehensive by including the sterilisation of meat from knackers yards.

In point of fact, whereas meat unfit for human consumption had to be sterilised before leaving a slaughterhouse, meat which was potentially more dangerous could leave a knackers yard after merely being subjected to staining.

The paper laid more emphasis on salmonellosis of calf origin but he had read that *Salm. cholerae suis,* while not being so consistently responsible for food poisoning as *Salm. typhimurium* or *Salm. dublin,* was more invasive and pathogenic and was, in fact, the cause of more than 40 per cent. of recognised fatal cases in man.

It would be interesting to know the viability of salmonellae in imported foodstuffs and the length of time one could expect these to remain contaminated.

With regards to the bacteriological examination of calves and meat carcases generally some indication would be welcomed as to how this could most easily and rapidly be accomplished. It should be extended to lairages and abattoir equipment which, no doubt, are frequently very heavily impregnated with these organisms.

Dr. Galbraith agreed that *Salm. cholerae-suis* gave rise to systemic infection rather than food poisoning in man. A few cases of human salmonellosis due to other serotypes were clinically enteric fever.

As to the period of survival of salmonellae in imported foodstuffs, he felt a bacteriologist should be asked for an opinion. The organisms seemed to survive for many months in material such as desiccated coconut.

On the question of the bacteriological control of animals at slaughter, the suggestion made by Dr. Buxton that animals for emergency slaughter should be examined bacteriologically was a very good one, and a start should be made on that. The existing Public Health Laboratories and veterinary laboratories could probably undertake this work.

Mr. de Garis (Reading) said that salmonella content was fairly constant in imported beef, the percentage being low, but in imported horse meat it was going up alarmingly. That meat, of course, was not subject to The Meat (Staining and Sterilisation) Regulations. It was now being used largely in pet shops, and it was not necessary to stain it. In certain areas the sale of that particular meat had leapt up a great deal and was being bought in the pet shops for human consumption. That could not be proved definitely, of course, but local Public Health Inspectors were certain that was happening, and in those particular areas it was found that salmonella infection in man had risen. It seemed to be associated with the people who were buying that sort of meat, and they were chiefly immigrants. To them it was first-class feeding compared with what they had before.

There was one big snag in the pet shop business, namely, it was possible to sell stained meat and unstained meat in the same shop, particularly if it were advertised as not for human consumption. 75 per cent. of that meat was going out for human consumption. If the meat had to be stained, the sales would drop overnight. It was found that there was a big increase in sales, particularly in some of the South coastal towns. There was also a large trade in tinned meats. There again the increase in some cases was nearly 90 per cent. Finally, it might be of interest to state that "Kit-e-Kat" was now known as "Jamaican Salmon"!

Mr. W. W. C. Gibson (Ipswich) said that his contribution would comprise the expression of personal opinions rather than the views of any official body.

Both Dr. Gibson and Dr. Galbraith mentioned the question of contamination of animal feeding-stuffs by salmonella as being a possible source of infection and it would seem, from both papers, that spread of salmonella by movement of animals rather than by feeding-stuffs was of much greater importance. Dr. Galbraith in his summary mentioned that, both from the veterinary and medical points of view, bacteriological control of animal feeding-stuffs seemed desirable. Mr. Gibson wished to point out one or two of the difficulties which might be involved in such a procedure.

He referred to a report by a working party of the Public Health Laboratory Service published this year which contained results of surveys on the contamination of animal feeding-stuffs by salmonella. Of the ingredient samples tested about 9 per cent. were positive for salmonella. The proportion of isolations in mixed feeds was reduced to about 3 per cent. There was a further reduction to approximately 0.3 per cent. of samples of mixed foods which had been cubed or pelleted. This type of food would seem therefore to be the safest due to the heat treatment involved in the process.

The report further showed that of approximately 60 isolations from ingredients there were only 3 instances of *Salm. typhimurium,* the remainder being exotic types. Similarly, of approximately 20 isolations from manufactured feeds *typhimurium* only occurred twice.

Salmonella contamination generally occurs in the high protein ingredients, mainly of animal origin, most of which are imported. If bacteriological control in order to reduce the incidence of contaminated material, is to be attempted, it would seem that some form of international control would be necessary as it would be a difficult task to sterilise large tonnages of foods after importation. Sterilisation must therefore take place at the time of manufacture of these ingredients. What sampling procedure could be followed to ensure that the samples were representative of the bulk?

Would Dr. Galbraith therefore comment on: (a) how he would suggest that bacteriological control might be attempted in view of the international difficulties and those of sampling, and (b) the relatively few isolations of *Salm. typhimurium* reported compared with exotic types probably of little importance in relation to the place of animal feeding-stuffs as a means of spread of salmonella infections in man and animal?

Dr. Galbraith, in reply, said that the dilution of salmonellae in the compounded end product did occur, and that pelleted foods contained on the average fewer organism than meals. Perhaps the process of manufacture was more detrimental to some salmonella types than others and this might be related to the appearance in man only of particular types present in raw materials.

Why *typhimurium* should be almost absent from feeding-stuffs manufactured from animals was difficult to say. It was certainly true that if animal feeding-stuffs were the cause of salmonella infections in human beings, it seemed on the whole likely that the infections concerned were those due to serotypes other than *Salm. typhimurium.*

He had not actually suggested the heat treatment of

animal feeding-stuffs but some bacteriological control. It seemed feasible that when a firm was considering buying an animal protein raw material, the firm should examine the material bacteriologically. In this way they could avoid buying from heavily contaminated sources.

Mr. F. V. Collins (Australia House) recalled that it was suggested that emergency slaughtered meat should be periodically tested bacteriologically. What was "emergency slaughter"? He had always understood it to refer to an animal under an emergency—an animal which had broken its leg or something like that. If a farmer had a cow which he realised would die unless he did something quickly, and he rushed it to an abattoir, that was not an emergency slaughter. It was sheer fraud. If a farmer could see that the animal was sick, then an inspector could also see that it was sick and it should be condemned. Mr. Collins said he knew an inspector in an area nearby, and he asked him whether he got any such cases, and the answer was "No, because they know I would condemn them." The animals were sent elsewhere where there was different inspection. That was a matter of control.

He took it for granted (though the matter needed much more investigation) that all abattoirs were more or less contaminated with salmonellae, but where carcases were soiled with salmonellae during the dressing and washing processes, it was obvious what action should be taken. And after the bacterial soilage had been kept to a minimum by improved hygiene of all techniques, the unavoidable soilage residue should be lowered still further by proper washing.

Thirty years ago the export beef industry of Australia was threatened with economic collapse because the English consumer refused to eat frozen beef, and it was necessary to improve hygiene to enable it to be sent chilled. Processes were instituted which came very close to levels of laboratory hygiene, and as a result beef from Australia and, of course, New Zealand was, and is delivered safely in Britain, chilled, up to 60 days or more old. If it is possible to remove spoilage organisms, which have contaminated carcases, one assumes that it is also possible to lower the bacterial load of salmonellae if such should exist. The only snag is the expense. If Englishmen were dying from infection with salmonellae, it was only a question of working out the value of their lives, and determining whether it was worth the cost of producing clean carcases!

Mr. Collins said he was told that salmonellae came into the United Kingdom in animal feeding-stuffs and fertilisers, but it must be remembered that in any properly equipped works all fertilisers were sterilised. The fertiliser departments of some abattoirs in Australia were so clean that one could almost have a meal off the floor. All the products of such factories were heated to 260° F. for several hours, so that the tallow-free material was absolutely sterile.

If salmonellae were found in such fertilisers it was not due to understerilisation but to later recontamination and such contamination could take place very rapidly. Prevention of this recontamination should surely not be beyond the wit of bacteriologists. But it would add to the cost of production.

Lastly, Mr. Collins said it would be of very great interest to learn whether there was any truth in the belief that the human being is more susceptible to salmonellae when he lived in a colder country. In Australia, human salmonellosis while known, was considered so unimportant that in some States it was not classed as a notifiable disease, whereas in Scandinavia the condition was regarded as a serious human ailment.

Mr. J. B. White (Salisbury) supported that which Dr. Gibson had said regarding the importance of the stress factor. Salmonella was found in calves imported as a rule to farms through dealers, and last year an investigation was carried out by the public health service in Salisbury and the V.I.O. centre at Bristol. They took a farm which had had salmonella on it each autumn for the last 3 years, and they swabbed every calf which came on to the premises. Samples were taken from the calf pens weekly, and waited for trouble to develop. It developed after about 3 to 4 weeks in an explosive fashion. It arose in almost all of a dozen calf pens simultaneously. All the calves were swabbed again, and it was found that something like 70 per cent. were giving positive swabs of *typhimurium*. Only the calves showing clinical disease were treated, and they amounted to no more than possibly 15 per cent. of the infected calves. The others got over the condition without any further trouble at all. He had received the same evidence from Dr. Paterson with the calves which he bought in the local markets. They were swabbed regularly and it was only a small percentage of the ones which were shown to be infected which in fact ever developed the disease.

One of the biggest stress factors was the sudden switch from milk feeding, which the calves had up to the time that they reached the market, to artificial meals without, probably, any great attempt to modify the impact of that change over in feeding.

Mr. D. G. Llewellyn (Cardiff) said that as a practitioner he felt that some method of control should be envisaged. Dr. Gibson stated that adult infection usually resulted in a carrier. With present therapeutic measures more adults tended to survive the acute phase, made a clinical recovery and became carriers. Was the time not now opportune to consider legislation to safeguard the public health and national herd by, first, the slaughter of adult carriers with partial compensation and, secondly, the restriction of movement on infected farms until negative swabs were obtained from the herd?

Dr. J. M. Ross (London) recalled that the Chairman quoted the late Sir William Savage, indicated the work which he had done on salmonella and suggested that the 2 excellent papers demonstrated the progress which had taken place. That progress had, however, been rather one sided, and the last 30 years had really been the bacteriologists' paradise. More and more organisms had been isolated as techniques had improved, and he was struck by the fact that although many types of salmonellae might be isolated from foodstuffs, not all of them caused disease in human beings. There were between 7 and 8 hundred different types of salmonellae, and many were being isolated from foodstuffs, but of those only a small proportion were currently found to cause disease in man. He wondered whether the time had not come to pause and to think again, particularly in view of the opening remark in Dr. Galbraith's paper that all the salmonella types were believed to cause disease in human beings. One wondered whether the reverse should not be the case, and there should be concentration upon those which were known to cause illness and not condemn foodstuffs simply because a salmonella type had been found. For instance, *Salm. hessarek* which had originally been isolated from a dead crow in Australia was often found in frozen egg, but had never been known, so far as he was aware, to have caused human disease.

The tendency was, of course, whenever there was an outbreak of salmonellosis in man to blame foodstuffs; but it had to be accepted that a percentage of the incidents certainly derived from human carriers or cross infection on which the papers had not laid much emphasis. Yet undoubtedly in man there was a large amount of salmonellosis due to cross-infection and not to foodstuffs at all.

He was rather doubtful about bacteriological control being advocated for animal foodstuffs. Salmonellae could often be isolated from imported food, but the country of source would state that on examination prior to export salmonellae had been absent. Indeed, in this country different workers had produced different results from the same foodstuff from the same tin. There was therefore some danger in trying to lay down bacteriological control.

Dr. Buxton said that throughout this discussion great emphasis has been laid by a number of speakers on various forms of stress as predisposing factors to the spread and development of salmonellosis in animals. During the past years much effort has been given to improving techniques for isolating and identifying the various salmonella serotypes, and to the application of serology and bacteriology to the detection of infected individuals. Comparatively little attention had been given to the relationship of stress to the pathogenesis of infection. From the discussion that afternoon it was clear that more research into the patho-

(*Concluded at foot of page* 1308)

Intensive Rearing of Calves for Veal and Baby Beef

BY

J. WILSON

F.M.S. (Farm Supplies) Ltd., London

SUMMARY.—The manufacture of high energy milk substitutes has made possible the economic production of veal and the trade in home produced, good quality carcases, is steadily increasing.

A high standard of feeding management and cleanliness is necessary and buildings should be insulated and draught proof. Calves may be reared in individual pens or group pens, and results on both systems are equally satisfactory.

To achieve the necessary quality and weight in a 10 to 12 week feeding period, the calf must grow without check and at an average rate of at least 2 lb. per day. Inclusion of antibiotics in the food increases the rate of growth and reduces the incidence of scouring.

At present, veal production is largely confined to the south of England and further development is largely dependent upon creating a demand for the product.

A system of feeding baby beef animals, based on home grown cereals and silage, is discussed and complete results for one group of animals, together with part results for a second group are given. Results indicate that the pure Friesian is capable of greater live-weight gains than the Hereford X Friesian, and therefore more suitable for this system of beef production. Concentrates are utilised more efficiently than silage and on the costings used, the most efficient diet is one which contains the highest proportion of concentrates. A hormone implant at a live-weight of 550 lb. may reasonably be expected to improve live-weight gain by 20 per cent.

Carcase quality and meat to bone ratio of the baby beef animal compares favourably with that for more mature animals.

Veal Production

THE rearing of calves on a milk substitute away from their dams is now common practice. Such substitutes are manufactured from the various milk by-products—skim milk, buttermilk and whey—together with added carbohydrate to replace the fat, and minerals and vitamins, and are suitable for feeding to newborn animals after the colostrum feeding period. The carbohydrates used include lactose, glucose, sucrose and cereal starches either raw, cooked, or predigested, all of which are of lower energy value than the butterfat they replace. Whilst this is of less importance in normal rearing where supplementary dry foods provide additional energy, it becomes of considerable importance when calves

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Studies of Human Salmonellosis in Relation to Infection in Animals.—*Concluded.*

genesis of these infections was required if methods of controlling salmonellosis were to be improved.

Dr. Galbraith, in reply, referred to the question of human *versus* animal origin of salmonellae causing food poisoning, and said that some years ago the human carrier was thought to be the origin of most salmonella infections occurring in human beings. When one looked further into outbreaks one often found that the organisms were brought into the catering establishment in food of animal origin and not by a human carrier.

Persons preparing food associated with an outbreak were frequently found to be infected, but their infection was usually the result of the outbreak and not its cause.

The human "carrier" or more correctly "symptomless excreter" was of importance in the local spread of human salmonellosis but the ultimate origin of the infection was probably animal.

The question of the control of foodstuffs containing salmonellae was a difficult problem. The presence of exotic salmonella serotypes implied faecal contamination, and this was more important than the particular serotype isolated.

In Australia an outbreak of typhoid fever was traced to desiccated coconut. This material frequently contained many exotic salmonella serotypes and very rarely *Salm. typhimurium*. One therefore had to take the view that when exotic salmonellae were found in a foodstuff it meant that the material was contaminated with faeces and liable to contain highly pathogenic salmonellae.

Dr. Gibson, in reply, said that the techniques used at various V.I. centres varied. He agreed with Dr. Buxton that indirect haemagglutination tests should be used to study carrier animals.

The question of the local purchase of calves had been raised. He agreed that one could rarely achieve that ideal. This led to the question of vaccination. Dr. Buxton had commented that recently purchased calves which had been through several markets were not the best material for vaccination. That was true, but the point was that one was trying to patch up a system of husbandry which, if not basically unsound, was on shaky ground. Therefore, it was necessary to put up with the second best approach. Vaccination might have something to offer in trying to patch up that type of husbandry.

The remarks made by Mr. Collins from Australia were of great interest. He mentioned the point that products that had been sterilised could so easily be recontaminated. However, some of the products about which one was more worried were not, as far as he was aware, subject to any sterilisation at all; only drying in the sun. Moreover one should not restrict oneself to the consideration of products of animal origin since several workers had shown that products of vegetable origin could also be contaminated with salmonellae.

Mr. Llewellyn's remarks emphasised the need for nursing measures alongside measures of specific treatment. It would be wrong to try to sidestep his question concerning legislation. Dr. Gibson said that he was in no position to provide an answer to the question, but thought that we should study what had been done elsewhere. It was a subject which had received a great deal of attention in other countries. Those concerned in this country should try to benefit from that experience, and, after appropriate studies, decide what measures, if any, might be appropriate in this country.

On the motion of the Chairman, a hearty vote of thanks was accorded to the authors of the papers and to the contributors to the discussion.

receive a milk substitute diet only. Consequently, fat is added to milk substitutes for veal production to give a final analysis of the order of 17 per cent. fat and 23 per cent. protein, compared with 1 per cent. fat and 23 per cent. protein in the standard type milk substitutes for normal rearing.

Interest in the use of fats in animal feeding has developed over the past 10 years as a result of improved methods of refining and of stabilising against deterioration, together with improved manufacturing techniques employed by the compounder. At the same time, the surplus of animal fat which is the result of the replacement of soap by detergents, has reduced its price to a level which compares favourably with that of milk powders. Various blends of fats and oils have been used in feeding trials, and whilst lard and tallow have consistently proved to be satisfactory (Hopper, Gardner & Johnson, 1954; Ritchey, Hopper, Gardner & Johnson, 1956; Larsen, 1958; Weber & Kaiser, 1958/59; Witt & Huth, 1959; Kesler, Wilson & Moore, 1960), results from the use of vegetable oils have been more variable (Kastelic, Bentley & Phillips, 1950; Lassiter, Duncan & Christie, 1957; Raven & Robinson, 1958/59/60). Hydrogenated whale and herring oil have also given satisfactory liveweight gains (Homb, 1960). Lard appears to be more suitable than tallow, but as it is also more expensive, a mixture of the two is generally used.

Various methods are employed for adding the fat to milk powders. The emulsified fat can be tipped, sprayed or blown on to the milk powder, resulting in a product in which the particles of milk are coated with globules of fat which range from 1 to 100 microns with the majority between 10 and 30 microns. Alternatively, the emulsified fat can be mechanically homogenised with liquid skim milk, and then either roller or spray dried. This method gives a product in which the globules of fat are enclosed in a coating of milk powder, and are comparable in size to those of whole milk (1–4 microns). In general, the smaller the fat globule, the greater is the rate of digestion, and there is some evidence that homogenisation improves utilisation of fat (Hopkins, Warner & Loosli, 1959; Roy, Shillam, Thompson, & Dawson, 1961). The spray dried homogenised product reconstitutes more easily than mixtures prepared by spraying the emulsified fat on to the milk powder.

Additional fat soluble vitamins A, D_3 and E are provided, and vitamins of the B complex, vitamin C and vitamin K are also generally included, although there is some doubt as to whether the addition of these last three are in fact essential. With the exception of magnesium, small quantities of which are added, the high inclusion rate of milk powder in the diet provides an adequate level of minerals. The question of iron deficiency anaemia warrants comment, if only because it has received so much attention from the Press recently. Whole milk contains only about 2 mg. iron per gallon, but few veal calves reared on whole milk die from iron deficiency anaemia. The reserve of iron in the body at birth must, therefore, be quite high, but it will be influenced by the diet of the dam. During the drying process the milk by-products take up a certain amount of iron and the milk substitute with which the writer is personally familiar contains 30 mg. iron per kg. dry matter. The limited information available on the iron requirement of the calf suggests a figure of 150 mg. a day for a weight gain of 2 lb. per day (Blaxter, Sharman & MacDonald, 1957).

This figure assumes a 30 per cent. utilisation and also provides for the maintenance of normal haemoglobin values and adequate liver storage. The gross requirement with no allowance for normal storage is estimated to be about 56 mg. per day (Matrone, Conley, Wise & Waugh, 1957). Even if a gross iron deficiency anaemia were desirable—which it is not—it is difficult to see how such a condition could be produced in 12 weeks when feeding a milk substitute containing 30 mg. Fe per kg. dry matter. Carcases from calves reared in metal pens did not differ in any way from those of calves reared in wood pens and fed a similar ration.

The effect of the calcium sodium balance on rennet coagulation of milk substitutes, and the importance of this during the first few days of life, was shown by Kastelic *et al.* (1950). The satisfactory performance of older animals, fed the rennet incoagulable milk, coincides with an increased development of gastric secretion after 2 weeks of age. More recent work by Frens (1960) suggests that at the high level of feeding practised in veal production, inadequate coagulation may result in the absorption of only partially digested protein from the intestinal tract which occasionally results in sudden death from anaphylactic shock. The addition of calcium chloride to the milk substitute reduced coagulation time, though not to a level comparable with the coagulation time of fresh whole milk. Because of this it is suggested that, where sudden deaths occur, increasing the number of feeds from 2 to 4 per day, particularly in the first month, and the use of less soluble protein as in roller dried skim milk, may have a beneficial effect.

Many workers have demonstrated the beneficial effect of antibiotics in calf rearing, and levels of 30 to 80 mg. of chlortetracycline or oxytetracycline per day usually reduce the incidence of scouring, improve growth rate by 5 to 25 per cent. and improve the efficiency of utilisation of the feed. Inclusion of antibiotics in calf foods is forbidden in this country, which places the home producer of veal at a disadvantage with competitors in other countries where the use of antibiotics in veal milk substitutes is freely permitted. There appears to be little justification for prohibiting the use of antibiotics in veal production whilst freely permitting their use for the production of meat in the pig and poultry industry. Any possible danger arising out of the development of resistant strains of bacteria should be measured against the potential overall benefit resulting from the use of antibiotics.

Stilboestrol has no effect on the incidence of scouring or mortality, and only a slight but non-significant effect on growth rate of calves up to 3 weeks of age (Lang, Roy, Shillam & Ingram, 1959).

Feeding Routine

A high standard of feeding management is necessary if calves are to achieve maximum live-weight gains. Calves should receive colostrum and milk for at least 4 days, followed by a 3 to 4 day changeover period on to the milk substitute. The usual level of reconstitution of the milk substitute is 11 to 12 per cent. but, during the initial stages of rearing, it may be advisable to feed at a much lower concentration gradually building up to full strength. Particularly is this so with bought-in calves which have passed through an open market, and where the diet is changed suddenly from milk to milk substitute. The level of feeding must be gradually but consistently increased from 1 gallon per day at the end of the first week, until towards the age of 12 weeks each calf is taking up to 3½ to 4 gallons per day in 2 feeds. Increasing the number of feeds up to 5 per day resulted in a lower intake because of the tendency to refuse food when offered at short intervals. Teat feeders gave no advantage over bucket feeding in the initial stages of rearing, and in the final stages of fattening, highest intake of food was obtained on bucket feeding.

As with all systems of calf rearing, cleanliness of feeding utensils and pens is important if the animals are to remain in good health and free from disease. When over feeding results in digestive disorders, the milk substitute should be withheld or reduced for 1 or 2 feeds and warm water and glucose offered in its place. In common with other systems of intensive production, a continual throughput of calves eventually results in a build-up in the incidence of scouring and mortality and a reduced live-weight gain. This fact was forcibly brought home to us when a batch of 12 market-bought calves, housed in a building which had been in continual use for 3 years, failed completely owing to a high incidence of scouring. After a period of 3 weeks the building was re-stocked and all calves given 200 mg. of oxytetracycline hydrochloride per day for the first 3 days. With antibiotic supplementation, only 1 calf tended to scour and by the end of the first week it was possible to feed all calves on a diet containing double the concentration of milk substitute to that given in the first batch. Producers have found, however, that for best results, houses must be rested for at least 2 months of the year. This build up of infection may be associated with serological types of *Escherichia coli*, which are pathogenic to the calf (Roy, Palmer, Shillam, Ingram & Wood, 1955); these workers found that a period of 7 weeks was sufficient to reduce the level of infection in the building, whereas one of 15 days was too short.

The production of veal from concentrated dry food has so far proved impracticable. During the first 3 months of life, the calf has a greater appetite for milk than for dry concentrates, and much higher growth rates are possible with liquid feeding. There is also a considerable difference in conversion of food to meat, in that over 80 per cent. of the dry matter of milk is utilised for maintenance and live-weight gain compared with about 50 per cent. of the dry matter from concentrates, which are subject to lower digestability, and to losses in the rumen as a result of bacterial fermentation. There is a further consideration for the producer in that the milk-fed calf has a much higher killing out percentage (55 to 64 per cent.) compared with up to 54 per cent. for calves reared on dry foods—because of difference in the weight of the intestines and their contents.

The labour problem of hand mixing individual buckets of milk substitute on a large unit can be overcome by the use of a bulk mixer. A suitable machine capable of mixing 24 gallons in a matter of minutes is available at a cost of approximately £15.

Housing

In earlier days it was thought that complete darkness and very high temperatures were necessary for intensive veal production, and it was not uncommon to find calves housed in small dark buildings with a straw stack built on top for added insulation. There is no evidence to show that darkness favours the production of white flesh, and to-day the recommendation is that the calves should be housed in buildings from which direct sunlight is excluded, and in which the temperature can be maintained at about 65° F. In subdued light there is less trouble from flies and the calves lie quieter. For many months of the year a temperature of 65° F. can be obtained only by good insulation and/or supplementary heating.

In the same way that opinions differ as to whether rearing calves should be housed in individual pens or group pens, so there are differences of opinion about veal calves. Results on both systems are equally satisfactory and both have their respective advantages and disadvantages. On the larger units, a small nursery separated from the main fattening section, houses the calves for the first 2 to 3 weeks after birth or purchase. Here the calves are penned in small groups and bedded down on straw to minimise the risk from chills. If they are thriving satisfactorily they are then transferred to the main unit, and housed in individual or group pens on slatted floors above a sloping concrete floor. A minimum of 10 sq. ft. of floor space per calf is required, but this is generally exceeded in all but the smallest of individual pens. Group penning requires a higher degree of management with the increased risk of spread of infection, trouble from calves sucking one another, and the problem of ensuring that each calf receives the correct quantity of food. The biggest disadvantage of individual pens is probably their initial cost.

Originally, crates were constructed with solid fronts and sides, measuring 2 ft. wide by 5 ft. long. These were later modified to slatted sides either running the full length of the pen, or shortened to about 3 ft. long, with the calf tethered on a short chain. Crates may be dispensed with completely, and the calves either tethered in a line or penned in small groups. Provided the buildings are well insulated and draught proof, any of these systems proves satisfactory. Floors consist of hard wood slats 3 in. wide with 1 in. gaps which permit free drainage of the urine into a dung channel at the rear of the crates.

The gap between the concrete and the slatted floor at the front of the pens, is sealed off by means of a hinged flap to minimise floor draughts. Good ventilation either by means of roof cowls or extractor fans is essential. While the above details indicate the conditions to be found in the large specialised units, the majority of producers have adapted existing buildings with considerable success. Straw and wood shavings are frequently used in place of a slatted floor, but these have the disadvantage of retaining moisture and unless frequently replenished become damp and cold. Hair balls are occasionally found in the rumens of the calves at slaughter but they do not appear to reach a size sufficient to cause trouble.

Carcase Quality and Marketing

The essential requirement is a well fleshed carcase carrying a thin layer of fat over the rump, back and shoulders and weighing between 120 lb. and 160 lb. dead-weight. To achieve this quality and weight in a 10 to 12 week period, the calf must grow without check, and at an average rate of at least 2 lb. per day with up to 2¼ lb. to 3 lb. per day in the final stages of fattening. Quality veal is still considered a luxury in this country and the main trade is centred on Smithfield Market. About half our total imports of veal carcases are from Holland, and over 2,500 tons were imported from that country in 1960. The total production of veal in the United Kingdom last year was over 19,000 tons compared with 14,000 tons in 1959, and 24,000 tons in 1938, but much of this was from bobby calves slaughtered soon after birth. Home production of quality veal is slowly increasing and is tentatively estimated at 400 fat calves per week. A number of provincial butchers are gradually building up a steady trade, and certain producers have set up small marketing organisations. Escalopes of veal are now competing with broiler chickens in some of the London restaurants. Marketing is still the greatest problem, and this has led to the formation of the British Quality Veal Producers Association, whose aim is to foster the production and marketing of high quality veal in the United Kingdom. The rapid development of a quality veal trade is at the moment hampered by the fact that 40 lb. bobby calf carcases are allowed to be sold under the classification of veal.

Production costs in the Netherlands do not differ greatly from our own, so there is no reason why we should not compete successfully with their export trade to this country. The average purchase price of Dutch calves of the bigger type is between £12 and £13. Food consumption is in the region of 3 cwt. per calf, giving a total cost of approximately £30. To provide a profitable return, these top quality calves must make at least £35 on the English market, and on present prices this is barely possible.

It is, therefore, to Italy, France and Germany that the Dutch farmer looks for his main market. Many of the farmers are financed by the food manufacturers who provide for the purchase of the calf and the food. The loan, plus interest at 3 per cent., is repaid when the calf is sold. In turn, the food manufacturer insures the calf for a premium of 15s. and receives compensation on a scale related to the age of the calf should death occur.

Calves reared for veal do not qualify for a subsidy or a guaranteed price, although there seems to be no legitimate reason why producers should not receive the same consideration as producers of beef, pork and lamb. In 1958, both the Milk Marketing Board and the National Farmers' Union were actively interested in the possibility of directing surplus milk into veal production. To find out if a subsidy could be paid for veal fed on whole milk alone, trials were carried out at Ministry experimental husbandry farms to determine whether it was possible to tell from the colour of the carcase if a veal animal had been fed on whole milk or on a milk substitute (Jackson, 1960). Results indicated that it was not possible, with certainty, to make such a distinction on the carcase, and consideration of a subsidy on veal was therefore not pursued.

Profitability

Profit is governed primarily by the price of the week-old calf, the cost of the food, and the price received for the carcase. The high prices paid for beef-type calves precludes their use for veal production. The pure Friesian is probably the most suitable, but is subject to high prices at certain times of the year. The greatest potential lies in the utilisation of pure dairy calves and extremely good results have been obtained with the pure Ayrshire. Strong Guernsey calves have also proved satisfactory, but results have been more variable than with Ayrshire. Pure Jersey calves have not proved suitable although a few producers are fattening the Angus × Jersey.

The average price received over the past year by 2 local farms for bobby calves sold either in the market or direct to the local slaughterhouse less cost of delivery, was £2 10s. for Guernsey calves, and £3 5s. for Ayrshire calves.

The price of veal milk substitutes is between £5 10s. and £6 10s. per cwt. delivered at the farm, and consumption per calf is between 2 and 3 cwt. over the 12-week fattening period. While a food conversion (lb. milk substitute per lb. live-weight gain) of around 1:3 is possible under good conditions, the average under commercial conditions is nearer 1:5, giving a food cost of 1s. 6d. per lb. live-weight gain.

As previously mentioned, marketing is the major problem and producers are well advised to organise a satisfactory outlet for their calves before contemplating veal production. Prices range from 3s. to 4s. per lb. dressed carcase weight, and although killing out percentages of over 60 per cent. are obtained with exceptionally good calves, the average is just over 55 per cent. Working on the basis of 1s. 6d. per lb. live-weight for the newborn calf; 1s. 6d per lb. live-weight gain food cost; a killing out percentage of 55 per cent.; and a labour and overheads charge of £3 per calf, a selling price of 3s. 3d. is required to cover production costs, plus a further 1d. per lb. to cover mortality and/or culls up to a level of 5 per cent. For a 10 per cent. net profit, the producer must, therefore, receive 3s. 8d. per lb. on the finished carcase. Outlets at this price are very

limited, but at least one organisation has, over the past year, supplied to farmers Friesian calves averaging at least 90 lb. at 1s. 6d. per lb. live-weight, and bought back the finished calf at prices ranging from 3s. 6d. to 3s. 11d. and averaging 3s. 7d. per lb. dressed carcase weight. If the inclusion of antibiotics in veal milk replacers was permitted, and if their use resulted in a 10 per cent. increase in live-weight gain, then the producer could afford to sell at 3s. 5d. per lb. and still maintain a 10 per cent. net profit.

Similarly, the dairy farmer who receives only a nominal sum for his bobby calves, and who can fit in veal production with his heifer calf rearing, can afford to accept a much lower price.

At present, veal production is largely confined to the south of England, where a trade in home-produced quality veal is steadily developing. Further development is largely dependent upon creating a demand for the product.

Baby Beef

The intensive production of beef has attracted considerable attention in recent months, and it was with a view to determining the profitability or otherwise of this method of production that we started trials in April of last year. To date, only 1 group of animals has been taken through to slaughter, but part results for a younger group are also included in this report. The aim was to produce an 8 cwt. animal in 12 months by a system of intensive feeding in which the animals never have access to grazing.

A batch of 28 Hereford × Friesian steer calves approximately 3 to 4 weeks of age, were purchased on April 1st for a calf feeding trial, and at 3 months of age the 10 most promising animals, average weight 262 lb., were selected for the baby beef trial. Similarly a batch of 26 three- to four-week-old pure Friesian steer calves were purchased on July 19th and at 3 months the 8 most promising animals, average weight 305 lb., were selected. Average food cost per calf over the 3-month period was £7 for Group A (Hereford × Friesian) and £7 10s. 0d. for Group B (Friesian).

Total floor area per head was increased from 15 sq. ft. in the calf pens to 20 sq. ft. over the period 3 to 6 months and finally to 30 sq. ft. from 6 to 12 months. Hay and straw were stored on a timber framework above the pens, which were littered daily and cleaned out at 3-monthly intervals.

The animals were group fed and figures are, therefore, an average for all animals within the group. Concentrates and silage were fed twice daily, with hay *ad lib*. Group A was fed 1½ gallons of milk substitute (1¼ lb. dry powder) per day during the 4th month, following which the level of concentrate feeding was gradually stepped up from 7 to 9 lb. per day. The ration was reduced to 8 lb. per day during the 6th month and further reduced to 5 lb. increasing to 6 lb. per day during the 7th month when silage was introduced. Group B was fed a lower level of concentrates but silage was fed from 3 months of age. At 9 months the ration of silage was reduced and the level of concentrate feeding increased.

Results

The performance of both groups is summarised in Tables I and II.

Analysis figures used in calculating dry matter

TABLE I

PERFORMANCE OF HEREFORD × FRIESIAN STEERS

Age months	Average live-weight lb.	Average daily live-weight gain lb.	Average daily food consumption			Dry matter intake per 100 lb. live-weight lb.	S.E. conversion ratio
			Concs. lb.	Hay lb.	Silage lb.		
4	354	3·0	7·0	1·8	—	3·2*	1·9
5	421	2·2	8·7	3·6	—	2·7	2·8
6	492	2·4	8·0	1·3	—	1·8	2·2
7	566	2·4	5·4	4·0	30	3·1	3·1
8	596	1·0	7·8	4·1	40	3·5	9·3
9	668	2·3	9·6	1·5	55·5	4·1	5·1
10	726	1·9	9·0	2·2	72·6	4·4	7·4
11	786	2·1	9·2	1·2	77·2	4·2	6·7
12	860	2·7	10·8	—	80·0	4·0	5·6

*—Includes milk substitute.

TABLE II

PERFORMANCE OF FRIESIAN STEERS

Age months	Average live-weight lb.	Average daily live-weight gain lb.	Average daily food consumption			Dry matter intake per 100 lb. live-weight lb.	S.E. conversion ratio
			Concs. lb.	Hay lb.	Silage lb.		
4	375	2·3	5	2·9	24·4	4·1	2·8
5	436	2·0	6	0·8	37·5	4·2	3·8
6	492	1·8	7	1·5	48·4	4·6	5·3
7	565	2·4	7·5	0·9	60·5	4·7	4·7
8	636	2·4	8·3	—	75·0	4·8	5·3
9	716	2·6	10·3	1·4	23·0	2·5	3·7

TABLE III
ANALYSIS OF FEEDING-STUFFS USED

	Dry matter	Protein	Fibre	Starch equivalent
Protein supplement	88	30·0	10·5	63
Oats	87	10·3	10·3	59
Sugar beet pulp	87	10·0	18·0	60
Barley	87	10·0	4·5	71
Hay	81	5·7	31·6	22
Silage	29	3·8	8·4	10·2

intake and starch equivalent conversion ratios are shown in Table III. The hay fed over the whole of the trial was from one stack and the silage from one pit, and analysis figures are averages of a number of samples.

TABLE IV
LIVE AND DRESSED CARCASE WEIGHTS

Ear number	Live-weight lb.	Dressed carcase weight lb.	Killing out percentage
1,729	868	480	55·3
74	868	458	52·8
37	954	540	57·9
68	868	468	55·0
49	871	478	54·9
92	840	476	56·7
17	860	483	56·1
37b	862	470	54·5
Average	874	481·6	55·1

Two animals were sent for slaughter on March 29th; one animal was sold in the market on April 4th, and six were sent for slaughter on April 10th. One steer, weighing 764 lb., would have failed to qualify for deficiency payment and was therefore retained on the farm for a further period of feeding. No allowance has been made for this in the costs and returns shown. Final live-weights were taken 24 hours after the last feed and the animals were slaughtered after a further 12 hours. Dressed carcase weights and killing out percentages for the 8 animals sent for slaughter are shown in Table IV.

Carcase Quality

The carcase weight and killing out percentage of Animal 1729 approximated to the average for all 8 animals, and a side from this animal was, therefore, selected for carcase appraisal. The quarters were jointed and boned for County Quality standard,* and figures for weight and percentage of bone also include gristle, trimmed from the meat. The percentage analysis for the joints is given in Tables V and VI, and results compared with good, average, and poor quality quarters (Gerrard).

Profitability

The 8 animals sold direct to the butcher realised 3s. 0½d. per lb. dressed carcase weight. The animal sold in the market scaled 7½ cwt. and returned £8 per cwt. plus deficiency payment of £1 16s. per cwt.; equivalent to 3s. 2d. per lb. dressed carcase weight assuming a killing out percentage of 55 per cent. Table VII shows the average total food consumption per head and margin over food cost.

Concentrates consisted of a mixture of 4 parts crushed cereals valued on the farm at £20 per ton, and 1 part 30 per cent. protein, mineral vitamin supplement costing £36 per ton. No charge has been made for bedding straw and no credit has been allowed for muck trodden down by the cattle.

* Kindly undertaken by Mr. T. H. Ratcliff, John Rayns Smith Ltd., St. Neots, Hunts.

TABLE V
FOREQUARTER
JOINT AS A PERCENTAGE OF QUARTER AND BONE AS A PERCENTAGE OF JOINT

Joint	Animal 1729 114 lb.				Good quality 190 lb.				Average quality 162 lb.				Poor quality 113 lb.			
	Joint as per cent. of quarter		Bone as per cent. of joint		Joint as per cent. of quarter		Bone as per cent. of joint		Joint as per cent. of quarter		Bone as per cent. of joint		Joint as per cent. of quarter		Bone as per cent. of joint	
Shin	7·4		46·5		5·5		38		6·0		41·5		6·2		46	
Clod	9·4		22·7		11·6		19·4		11·7		24·5		11·8		26	
Sticking	8·4		25·2		8·1		14·7		9·9		15·4		10·9		16	
Brisket	9·9		19·9		13·6		18·2		13·0		18·8		9·5		31·5	
Flank	7·4		13·7		9·7		9·5		10·0		12·2		8·1		15·8	
Forerib	9·9		18·9		11·9		12·7		10·9		18·3		12·9		26·5	
Leg of mutton cut					7·1		3·7		6·0		5·3		9·0		5·6	
Blade bone ...	7·6		18·8		4·6		15·0		4·6		13·5		4·5		15·8	
Chuck	16·8		17·7		8·2	39·6	11·2	9·3	7·3	38·5	12·5	12·3	7·4	40·5	25·5	16·3
Back ribs ...	9·5	43·6	2·9	13·6	11·0		10·3		10·7		15·4		10·1		20·5	
Top ribs	8·3		15·2		8·7		7·9		9·9		12·5		9·5		15·8	
Trimmings ...	1·4															
Loss in cutting, including hanging and maturing for one week	4·0															
Per cent. of bone in quarter.			18·4 per cent.				14·3 per cent.				17·2 per cent.				22·6 per cent.	
Meat : bone ratio			4·2 : 1				6 : 1				4.75 : 1				3·45 : 1	

TABLE VI
HINDQUARTER
JOINT AS PERCENTAGE OF QUARTER AND BONE AS A PERCENTAGE OF JOINT

Joint	Animal 1729—126 lb.						Chilled Hindquarter—187 lb. Good conformation, reasonably light in the bone, fairly well finished					
	Weight lb.	Weight oz.	Per cent. of hindquarter	Bone weight lb.	Bone weight oz.	Bone as per cent. of joint	Weight lb.	Weight oz.	Per cent. of hindquarter	Bone weight lb.	Bone weight oz.	Bone as per cent. of joint
Rump	20	4	16·0	3	0	14·8 } 16·4	26	0	14·0	4	0	15·4 } 13·02
Loin	22	8	17·9	4	0	18·3 }	37	6	20·0	4	4	11·4 }
Topside	14	5	11·4	—	—		20	5	10·8	—	—	
Thick	10	15	8·7		5	2·8	20	10	10·9		7	2·0
Silverside	21	9½	17·1	4	5½	20·1	31	10	17·0	5	10	17·6
Flank	9	1	7·2		3½	2·4	13	3	7·0		7	2·6
Leg	12	15	10·3	4	13	37·2	14	5	7·6	5	6	38·0
A.B. Skirt		14½	0·7	—	—		1	4	0·7	—	—	
Goose Skirt ...							1	8	0·8	—	—	
Kidney	1	0	0·8	—	—		1	4	0·7	—	—	
Rump Suet ...		14	0·7	—	—		2	2	1·2	—	—	
Kidney Knob ...	4	8	3·6	—	—		9	12	5·2	—	—	
Cod Fat	2	12	2·2	—	—		5	0	2·7	—	—	
A. Bone	1	8	1·2	1	8		2	4	1·2	2	4	
Trimmings ...		11	0·5	—	—							
Loss in cutting, including hanging and maturing 1 week	2	3	1·7	—	—			7	0·2	—	—	
	126	0		18	3		187	0		22	6	
Per cent. bone in quarter		14·4 per cent.							12·0 per cent.			
Meat: Bone ratio		5·8 : 1							7·4 : 1			

Two animals, Nos. 37 and 68, were given an implant of 60 mg. hexoestrol at 9 months, and over the last 3 months showed an improved live-weight gain of 41.5 lb., equivalent to an additional £3 10s. per head, over the untreated animals.

TABLE VII
TOTAL FOOD CONSUMPTION PER HEAD AND MARGIN OVER FOOD COST

	£	s.	d.	£	s.	d.
Purchase to 3 months	7	0	0			
3 months to slaughter —						
46½ lb. milk substitute, £5 per cwt. ...	2	1	6			
22 cwt. concentrates @ £23 4s. per ton	25	10	6			
5½ cwt. hay @ £10 per ton	2	15	0			
5 ton silage @ £4 per ton	20	0	0			
Total food cost ...				57	7	0
482 lb. @ 3s. 0½d. per lb.	73	6	0			
Calf Subsidy	9	5	0			
Returns				82	11	0
Margin over food cost				25	5	0

Discussion

The results show that well reared Hereford × Friesian, and pure Friesian steer calves, fed liberal quantities of concentrates and good quality, high dry matter silage, are capable of an average daily live-weight gain of 2¼ lb. over the period 3 to 12 months. The exceptionally high dry matter intake per 100 lb. live-weight can be attributed only to the excellent quality of the silage.

If breed differences may be ignored, a comparison between Groups A and B over the period 3 to 6 months, shows that concentrates are utilised more efficiently than silage. The average daily live-weight gain of Group A animals over this period was 2.5 lb. with a starch equivalent conversion ratio of 2:3, compared to a daily gain of 2.0 lb. with a starch equivalent conversion ratio of 3:9, for Group B animals. Similarly, reducing the quantity of silage, and increasing the level of concentrates fed to Group B animals during the 9th month, resulted in an improved live-weight gain and starch equivalent conversion ratio. A further incentive to replacing silage, either wholly or partly, with concentrates, is the lower cost per unit of starch equivalent from concentrates. Using analysis figures and costs in Tables III and VII, the cost per ton of starch equivalent from concentrates and silage is £33 and £39 respectively. This suggests that the most efficient diet is one which contains the highest possible proportion of concentrates. In a preliminary trial, 4 animals bedded down on straw and fed concentrates only over a period of 11 weeks, gave an average live-weight gain of over 2½ lb. per day, with no digestive upsets.

The highest daily live-weight gain, and the lowest starch equivalent conversion ratio, was obtained in the period of milk substitute feeding. Whilst the cost per unit of starch equivalent in milk substitutes is considerably higher than in dry concentrate mixtures, extending the liquid feeding period to 4 or 5 months as opposed to earlier weaning at 2 months, may prove to be economical in the production of baby beef. If the feeding of milk substitute results in a higher intake of nutrients and greater live-weight gains than is possible on concentrate feeding, then

the age at which the animal will reach the necessary slaughter weight, will be reduced. It may, therefore, be more economical to aim for the maximum live-weight gain in the early stages of growth when feed conversion ratio is lowest.

The food cost per lb. live-weight gain in Group A animals over the month in which milk substitute was fed, was 12.5d. compared to 10.4d. per lb. over the following 2 months; a reduction in food cost of 2d. per lb., but accompanied by a reduced live-weight gain of 25 per cent. Trials in progress include groups of animals weaned from milk substitute at 2 and 5 months of age, and the *ad lib.* feeding of concentrates with no roughage.

Because of different systems of feeding it is not possible to make a direct comparison of live-weight gain and efficiency of food conversion between the 2 groups of animals. Results indicate, however, that the Friesian is capable of greater live-weight gains than the Hereford × Friesian, and therefore more suitable for this system of beef production. At 3 months the pure Friesian weighed 43 lb. a head more than the Hereford × Friesian. Over the next 3 months, Group A gave the highest gain but this was probably the result of better feeding. At 9 months, the Friesians were 48 lb. a head heavier than the Hereford × Friesians, with better developed hindquarters, but less well fleshed over the back and shoulders.

A different system of cutting the carcase, particularly the forequarter, accounts for the wide difference between some of the joints from the baby beef animal, and the results quoted by Gerrard. The baby beef animal lacks the body depth of the more mature animal and consequently the brisket and flank represent a much lower percentage of the carcase. Similarly, suet and fat accounted for a lower percentage of the carcase of the younger animal. The percentage of bone in a forequarter varies from 14 per cent., in a good quality heavy quarter, up to 23 per cent. in a poor quality small quarter; whilst the bone content of hindquarters varies from 12 to 17 per cent. A bone content of 18.4 and 14.4 per cent. in the fore and hind quarters from the baby beef carcase is, therefore, satisfactory, and compares favourably with results from an average quality carcase.

A hormone implant at a live-weight of 550 lb. may reasonably be expected to improve live-weight gain by 20 per cent., and increase returns by approximately £5 per animal. Increasing the level of concentrate feeding may result in more efficient gains but a system of feeding based on home grown cereals, and silage, fits in well with many farming systems.

It has been the aim of this discussion to provide some information on the results which may be expected under such a system of feeding.

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The Speaker's Introduction

The Chairman, Mr. S. L. Hignett, said that a year or two ago, the so-called broiler calf production excited a great deal of interest, not only among farmers but also among those concerned with animal welfare. In the latter group, there was a number of people concerned about the treatment meted out to calves being reared on more intensive lines. As a result, it was decided that Mr. Frederick Burton, Chairman of the Animal Welfare Group in the House of Commons, and the then President of the B.V.A. should go to Holland to see this system as practised in that country. A report on that visit appeared in THE VETERINARY RECORD in July, 1960.

The Association was fortunate in having as their principal speaker Mr. John Wilson, Chief Technical Officer of F.M.S. (Farm Supplies) Ltd. Mr. Wilson had devoted the last 10 years to an intensive study of the nutrition of farm livestock, and it would be difficult to imagine anyone better able to discuss that particular subject. He called on Mr. Wilson to introduce his paper entitled "Intensive Rearing of Calves for Veal and Baby Beef."

Mr. J. Wilson said that, when preparing his paper on veal and baby beef production, he assumed, he hoped correctly, that it was the Committee's intention that the subject should be dealt with more from a practical and commercial aspect, rather than from a purely scientific point of view. The type of work which his firm was equipped to undertake was largely confined to an examination of the practical problems of feeding, management and housing, and their application to everyday farming practice. He proposed to deal first with the section on veal production and then go on to the work done on rearing for baby beef.

Milk substitutes used in the production of veal differed from the standard type of milk substitute in that they contained a much higher level of fat. Various blends of fats and oils had been used in feeding trials, and while lard and tallow had consistently proved to be satisfactory, results from the use of vegetable oils had been more variable.

Fat soluble vitamins A, D_3 and E were provided, and vitamins of the B complex, vitamin C and vitamin K were

also generally included, although there was some doubt as to whether the addition of the last 3 were in fact essential. With the exception of magnesium, small quantities of which were added, the high inclusion rate of milk powders in the diet provided an adequate level of minerals. Based on the information available on the iron requirement of the calf, the milk substitute with which he personally was familiar, appeared to provide an adequate supply.

Many workers had demonstrated the beneficial effect of antibiotics in calf rearing, and levels of 30 to 80 mg. of chlortetracycline or oxytetracycline per head per day usually reduced the incidence of scouring, improved growth rate by 5 to 25 per cent., and improved the efficiency of utilisation of the feed. Inclusion of antibiotics in calf foods was forbidden in this country, which placed the home producer of veal at a disadvantage with competitors in other countries, where the use of antibiotics in veal milk substitutes was freely permitted. There appeared to be little justification for prohibiting the use of antibiotics in veal production, while freely permitting their use for the production of meat in the pig and poultry industry. Any possible danger arising out of the development of resistant strains of bacteria should be measured against the potential over-all benefit resulting from the use of antibiotics.

A high standard of feeding management was necessary if calves were to achieve maximum live-weight gains. Calves should receive colostrum and milk for at least 4 days, followed by a 3- to 4-day changeover period onto the milk substitute. The level of feeding must be gradually, but consistently, increased from 1 gallon a day at the end of the first week, until, towards the age of 12 weeks, each calf was taking up to 3½ to 4 gallons a day in 2 feeds. As with all systems of calf rearing, cleanliness of feeding utensils and pens was important if the animals were to remain in good health, and free from disease.

In earlier days, it was thought that complete darkness and very high temperatures were necessary for intensive veal production, and it was not uncommon to find calves housed in small dark buildings, with a straw stack built on top for added insulation. There was no evidence to show that darkness favoured the production of white flesh, and to-day the recommendation was that the calves should be housed in buildings from which direct sunlight was excluded, and in which the temperature could be maintained at about 65°F.

In the same way that opinions differed as to whether rearing calves should be housed in individual pens or group pens, so there were differences of opinion about veal calves. Results on both systems were equally satisfactory, and both had their respective advantages and disadvantages. Group penning required a higher degree of management, with the increased risk of spread of infection, trouble from calves sucking one another, and the problem of ensuring that each calf received the correct quantity of food. The greatest disadvantage of individual pens was probably their initial cost.

With regard to carcase quality, the essential requirement was a well-fleshed carcase, carrying a thin layer of fat over the rump, back, and shoulders, and weighing between 120 lb. to 160 lb. dead-weight. To achieve that quality and weight in a 10- to 12-week period, the calf had to grow without check, and at an average rate of at least 2 lb. per day, with up to 2½ lb. to 3 lb. per day in the final stages of fattening. Marketing was still the greatest problem, and that had led to the formation of the British Quality Veal Producers' Association, whose aim was to foster the production and marketing of high quality veal in the United Kingdom.

The rapid development of a quality veal trade was at the moment hampered by the fact that 40 lb. bobby calf carcases were allowed to be sold under the classification of veal.

Prices paid to the producer for quality veal ranged from 3s. to 4s. per lb. dressed carcase weight. To cover production costs and to provide a reasonable margin of profit, the producer had to receive in the region of 3s. 8d. per lb. on the finished carcase. At present, veal production was largely confined to the South of England, where a trade in home produced quality veal was steadily developing. Further development was largely dependent upon creating a demand for the product.

Turning to the work on baby beef production, the aim was to produce an 8 cwt. animal in approximately 12 months by a system of intensive feeding, in which the animals never had access to grazing. Feeding was based on hay, silage and concentrates, which consisted of crushed barley, and a protein, mineral, vitamin supplement.

Complete results were given for a batch of Hereford × Friesian steers which left a margin over food cost of £25 4s. a head. A side from one carcase was jointed and boned and results were found to compare favourably with those from an average quality carcase from a more mature animal.

Two animals were given an implant of hexoestrol at 9 months, and over the last 3 months showed an improved live-weight gain of 41½ lb., equivalent to an additional £3 10s. per head, over the untreated animals.

Part results were also given for a batch of pure Friesian steers, which trial had now been completed. Direct comparison between the 2 groups was unfortunately not possible because of the different time of the year in which the trial was conducted; the variation in the method of feeding, with the Friesians receiving more concentrates and less silage, and because all the Friesians were given a hormone implant at 7 months. Nevertheless, it was interesting to note some of the differences.

At 12 months, the average weight of the Friesians (923 lb.) was 63 lb. a head more than the Hereford × Friesians. Although heavier at 12 months, the Friesians did not show the same degree of finish, and were therefore taken to 13 months of age before going for slaughter, at an average weight of 990 lb.

On the ration costings used, the food cost for the Friesians was 10s. a head more than for the Hereford × Friesians, but live-weight gain was 138 lb. a head more.

The average killing out percentage of the Friesians was 56.25 compared to 55.1 for the Hereford × Friesians—a difference of 1.15 per cent., which made a difference of over 30s. a head.

The margin over food cost for the Friesians was £24 3s. a head, £1 a head less than for the Hereford × Friesians. There were 2 reasons for the lower margin. Firstly, one animal in the Friesian group damaged its shin at 10 months of age and was sent for emergency slaughter. It failed, by 25 lb. to qualify for minimum dead-weight on which the beef subsidy was paid. That amounted to about £16, or approximately £2 a head on the group.

Secondly, because of the difference in the prices paid for beef animals in April and August, the Friesians sold at 3½d. per lb. dressed carcase weight below the Hereford × Friesians, which made a difference of £7 18s. a head.

The results from the 2 trials indicated that a reasonable margin of profit might be expected from an intensive system of beef production where calves were purchased in late autumn or winter and sold in the spring at 12 to 15 months of age, when beef prices were at their height.

Slides were then shown illustrating the type of animals produced.

The Opener

The Chairman said that the discussion would be opened by Mr. J. B. Makinson, who had for some years been working on the management and feeding of cattle. He would be well known to most of those present and needed no introduction. He was Senior Cattle Adviser to Vitamealo (A.F.P.) Ltd.

Mr. J. B. Makinson said that Mr. Wilson had spoken on 2 subjects which were very much in the news and one of them, veal production, had unfortunately attracted some rather hysterical comments in the national press. It was therefore very timely that the subject should be dealt with clearly and adequately and he wished to offer his most sincere congratulations to Mr. Wilson on producing a clear, detailed and accurate account of all aspects of veal production.

It would be presumptuous of him to offer any criticisms of such an excellent paper and he wished only to emphasise 2 points made by Mr. Wilson.

Firstly, he considered that anyone who intended to go in for veal production had to make quite sure that the marketing of his finished products had been arranged properly because that was the key to his profit or loss. Several people to-day or in the last few months had made a rather disastrous failure of veal production, not because they had not produced some quite good calves but because they had sold them at utterly ridiculous prices.

The second point he wished to emphasise was that veal production was a specialised type of enterprise and was not for the farmer who could not rear calves very well anyway. It required, undoubtedly, a high standard of management, feeding and housing, and a lot of thought had to go into the design of the houses, and quite a lot of care had to go into the feeding of the calves.

Unfortunately, any intensive feeding method was liable to lead to extra diseases, and the worst one was scouring. However, it had been shown that owing to the high standard of management required, that particular disease could be controlled, in fact, by top-class management.

In his paper, Mr. Wilson had mentioned the use of antibiotics. It might be necessary or advisable in the first few days of feeding to add antibiotics to the feed, but his own view was that that should be done under the supervision of a veterinary surgeon. He appreciated that antibiotics could be obtained and were being used by farmers quite indiscriminately. He thought they were very foolish because there could be other troubles arising as a result of their indiscriminate use. He always made a point of telling any veal producer that if he must use antibiotics, he must have a chat with his veterinary surgeon about it to ensure that he did not use them for too long and did not cause other troubles as a result of using them.

He then showed one or two slides to illustrate certain aspects of veal production. The first showed a typical veal house in Holland with crates. An important point was the flaps along the floor underneath the crates to prevent draughts going under the crates and up to the calves. It was important to keep them warm and draught-free. It would be seen that there was plenty of light in the house and that it was very clean and hygienic.

The next slide showed a condition seen occasionally which was of very bad hair loss all down the front legs and all down the back legs. This was due to several causes. One of them, and probably the main one, was the fact that some calves continually licked themselves in order to get some fibre because the foods used in the process were practically free from fibre. Another reason was the physical action of the fat in the milk on the skin of the calves. It was not a nutritional factor. If the fat was put on the skin of the calf, the hair would be removed and some of it was therefore due to milk having slopped down the front legs and from the fat in the dung down the back legs. He thought the calf shown had some other disease although the veterinary surgeon in Holland who had shown him the calf had not been prepared to say what he thought was wrong with it.

The third showed a collection of hair balls which were removed from the rumen of calves at slaughter. One was over 6 in. in diameter. It was not uncommon for calves to have one of these in their rumen, or in fact several small ones. When he had first seen them, it made him wonder, because there had been many times when it was suggested to owners of calves that one of the troubles due to indigestion was straw and hair balls collecting in the rumen, and yet calves could apparently thrive and grow very well with these in their rumen, at 16 weeks of age.

Turning to beef production, with due respect to Mr. Wilson, he considered that that was by far the more important of his 2 subjects, particularly in regard to the economic aspects both for the farmer and for the country in general.

In his view, if beef production was going to continue in this country, it must be done on lines which were much more sound and much more efficient than in the past and he felt that the intensive methods which had been described so well by Mr. Wilson were here to stay. They provided the farmer with the maximum use of his own farm produce, of grain and succulent crops. They provided him with a very much quicker turnover and therefore more profit; they undoubtedly provided better beef for the consumer and he was sure that the methods were going to become increasingly popular. After all, the main change was in the fact that different types of farm feeds were being advocated; whereas in the past, turnips and hay and silage were used in large quantities and naturally must have taken a long time to produce the finished beast, it was now advocated that high energy foods should be used in the form of barley so that the method still provided the farmer with a means of using his own feeds. Although methods of feeding might change, it was absolutely essential that the farmer should make the most use of his own feeds because the feeding had to be as economical as possible and that was the best way to do it.

In early experiments, on his company's research farm, they had used the feeding method of giving a lot of roughage and a limited amount of concentrates and had found the same as Mr. Wilson, that the concentrates gave better results than the roughage. Unfortunately on most farms the quality of roughage, hay and silage particularly, varied considerably in its nutritional value, and whereas the products used in Mr. Wilson's trials were obviously of a very high nutritional value, most farmers did not manage to make hay and silage of that quality. Therefore, there could be variable results in weight gains. In later trials, his company had tried to obtain the maximum growth in the early stages because it was in the first few months of the calf's life that it could be made to grow very rapidly indeed. They had not used quite the same methods as Mr. Wilson suggested—feeding liquid feeds for 4 or 5 months—but used the veal type of rearing and got, in effect, the same results. It was found that the results were very much better; the weight gains were much more consistent and much more rapid but unfortunately, it was found to be far too costly.

He then showed a slide to illustrate what happened in the trials. In the first trial, the concentrates were fed to a maximum of 10 lb. with some beet pulp and hay *ad lib.* The average daily gain was not so good and it was variable and fluctuating. It was concluded that that was almost certainly due to the varying quality of the roughage because that was providing, in fact, quite a large amount of the necessary nutrients for fattening.

In the third trial, intensive rearing was used in the first instance, and nearly 2 months were saved in arriving at the same weight. The average daily gains were very much more consistent. In this trial concentrates were fed to 7 lb. a day and barley *ad lib.* On this particular system of feeding, some of the animals consumed as much as 20 lb. a day concentrates and barley. The live-weight gains were better and the average daily gains more consistent.

In the latest trials, it had been shown that the best way to produce intensive beef was to obtain the maximum *economic* gains in the early stages, and a compromise had been reached whereby they fed the veal type of milk substitute, as described by Mr. Wilson, for a limited amount of time—about 8 weeks—and in a restricted quantity, because that also was a most expensive type of feeding. That was then followed by a good rearing ration which contained vitamins and minerals, particularly vitamin A. A very good paper was published recently in THE VETERINARY RECORD on the necessity for intensively kept animals to have an adequate supply of vitamin A. . The rearing ration was fed in a restricted amount all through the life of the animal and its appetite was satisfied with extra barley; the roughage part of the ration, was restricted to a maximum amount of 5 to 6 lb. a day. Using that method, it was found that there was a very reasonable profit in the system, and that it made maximum use of farm grown produce.

Mr. Wilson mentioned that he was carrying out trials with the use of concentrates only, and that particular method had also received a great deal of publicity lately. He himself was rather worried about that type of feeding because it provided virtually no fibre in the right form for correct ruminal function. He appreciated that if animals were bedded on straw, they would get some fibre by eating the straw but it was common to bed the animals on slats or sawdust. He could see no advantages in that system;

the weight gains were no better and it would seem that the digestion was not so good. He would like to have Mr. Wilson's opinion on the lack of fibre in the foods and whether it was not better to supply a certain amount of fibre in order to obtain proper ruminal digestion without the necessity of using artificial methods such as the addition of various drugs.

These days, it was possible for any intensive system such as had been described to be carried on absolutely and completely automatically. It was possible to obtain Auger feeders which would deliver any desired amount of food in any given time. The animals could be housed on slatted floors and could be watered from automatic bowls. The slatted floors did away with dung removal; theoretically that meant that no attention whatsoever needed to be given to them, but he could not help feeling that, particularly with regard to any form of livestock production with cattle, the best results would always be obtained from good stockmanship. He was sure it was necessary to institute some sort of routine procedure to allow the stockman to go in with the cattle every day.

To return to veal production, did Mr. Wilson think that this country could compete with Dutch producers by using the cheaper types of dairy calves, or might it not be that the quality of the carcases would suffer in comparison with those of the Dutch producers, and their very high standards.

He thanked Mr. Wilson for an interesting and stimulating paper which had given a great deal of food for thought and discussion.

The General Discussion

Mr. Wilson said that in the trial in which no roughage was fed, the cattle had roughage in that they consumed a certain amount of bedding. He was by no means certain that the system now being tried, of *ad lib.* feeding of barley, was the right one; it was merely another look at the problem to see if present results could be improved.

Unfortunately, the trial which he said had been started had to be stopped because of quite a serious outbreak of virus pneumonia in the cattle when they were about 4 months old. Until then, when they were being fed a mixture of barley, and were bedded on straw, each time they were bedded down, the animals ate a quantity of straw and if the bedding down was skipped for a day or two, a variation in the amount of concentrates eaten was seen.

The live-weight gains had been quite good, 1.9 lb. per day, 2.1 lb. per day and, in the third month when the virus pneumonia struck, 1.6 lb. per day.

On the method of combatting the virus pneumonia, they had had little choice in the matter. One calf had been lost and it was obvious, if the trial had been continued in the building, some more would probably have been lost so the solution was taken of turning the calves outside. They had never been out before in their lives. They were all put out and feeding continued on concentrate mixture. The calves showed remarkable recovery, illustrated by the average daily gain of 1.6.

On competing with the Dutch with their veal, he was not sure if it was desirable to look at it from that point of view. There was a market in this country for veal; a large quantity of bobby veal was sold. Could not that product in some way be improved, which at present was being sold, not necessarily competing with the Dutch. If that competition had to be faced—and it certainly looked as if it would—then they could not compete unless they did as the Dutch had done, which was to use antibiotics. Some farmers themselves were using them at present, and he suggested that that was considerably worse than permitting them to go in the food, because it was an impossibility for farmers to measure out accurately on the farm the small quantity required; there was therefore a very grave risk of antibiotics being used in excess and at much higher levels than necessary.

Mr. F. R. Spratling (School of Veterinary Medicine, Cambridge) wondered whether the veal calves should really be regarded as ruminants or not. He had spent a little time observing them alive but had not yet seen the alimentary tract at slaughter. That might give the answer but, in life, he had failed to detect a rumen at all, by ordinary clinical means, although he had been astonished to see them chewing the cud. That was in a calf house where the farmer allowed them a little hay. He had asked him why he was doing that and all the farmer could say was that he thought it made them happier. He could not really explain what he meant by this statement, but he was afraid that giving hay might make the meat too coloured. He had only just started doing it and none had gone for slaughter.

The point was an important one because if they were not to be regarded as ruminants, it might be necessary to think quite differently about how their digestive disorders were to be treated.

When Mr. Makinson was attacking the use of antibiotics, he had sympathised with him, but he wished that Mr. Makinson had been less vague about the "other troubles" which might arise from their use.

Mr. Wilson said that if the conclusion could be reached that the veal calves were not ruminants, probably a lot of difficulties would be solved on the question of feeding antibiotics. The development of the rumen was very, very small, practically negligible. It was obviously influenced by whether the calf was bedded on straw or on a slatted floor. On a slatted floor, it was practically nil; there was a slight development on straw.

It was the practice of some veal producers to give a couple of small handfuls of hay once a week to their veal calves and it was claimed that that had a benefical effect in improving over-all digestion and well-being of the calf, and in reducing scouring. The calves would ruminate because, given the opportunity, they would take small quantities of straw or, if there was sacking, they would take sacking. Occasionally, they would gnaw the wood of the pens or they would ruminate on hair licked from their own bodies. A certain amount of cudding would take place in that way.

Mr. Makinson said that he did not think it was necessary to use antibiotics even in calves which were bought from outside sources and which were not reared on the farm of the producer. However, a number of people bought their calves from all sorts of places, including markets, and it would seem, in practice that the giving of an antibiotic for 3 or 4 days after the purchase of the calf tended to prevent scouring, and tended therefore to lead to better weight gains. What he was so afraid of was that the farming community were rather notorious in assuming that because a little would do some good, a lot would do a lot more good, and they would feed large quantities of antibiotics throughout the life of the calf. He had recently seen a farm where an outbreak of scouring had occurred in a veal house when the calves were about 8 to 9 weeks old, and it was extremely difficult to account for it. Antibiotics were being used for longer than the first 3 or 4 days. Whether or not it was possible to produce resistant organisms under that system and using antibiotics, he did not know. What he did know was that the intensification of the system must be very much in favour of the multiplication of bacteria, and possibly some bacteriologists might be able to comment on that. But it seemed to him that that, plus the use of antibiotics, rendered their value much less, if they were used throughout instead of using them in the first few days where they seemed to have an advantage.

Mr. W. W. C. Gibson (Ipswich) said that, in his paper, Mr. Wilson had shown the profitability of producing baby beef as a margin over food cost of £25. If one allowed something like £12 for a calf and £6 5s. for labour and overheads, it reduced the net profit to somewhere about £6 to £7 per animal. He wondered whether that margin was really sufficient to attract farmers to produce that type of beef.

The discussion had brought out various ratios of roughage to concentrate as the ideal method of feeding the animals. Mr. Wilson's rations, by and large, had a ratio of less than 1 of roughage on a dry matter basis, to 1½ of concentrate, whereas recent American work had indicated that perhaps the best results were obtained where a proportion of roughage to concentrate of 1:5 was used; the most economic result was achieved on something like 1:3. Mr. Makinson suggested that restricting roughage to about

5 to 6 lb. per day might be the right answer; by restricting roughage, would it not increase the killing out percentage from the 55 or so obtained by Mr. Wilson, giving another 1 to 2 per cent. of meat, and thus increasing the economics of the whole system?

Mr. Wilson replied that Mr. Gibson had rightly pointed out that the profitability on the first complete set of figures was not very high, when the numbers of calves and overheads were taken into consideration. It would be easier if there was some indication of the profitability of the standard method of producing beef, which he had tried to obtain when doing the work and which he could honestly say no one had been able to give him. Based on the work done, and assuming beef prices from January to June, one could expect a margin of something like £30 to £34 a head on that system of feeding. Obviously that was not applicable all the year round. That was why he had suggested that the greatest margin of profit would be obtained by taking the calves in the late autumn or winter when prices were at their lowest, and selling them the following spring when beef prices were at their highest. If the margin of £30 plus could be achieved, allowing £10 for the calves and overheads of, say, £6, the margin of profit was good.

Obviously, the crux of the matter lay in the price paid for the baby calves. If one had to pay £25 or so a head for a Hereford × Friesian, one could not do it because, working on the live-weights achieved (the Hereford × Friesian costing an extra £10 or so above the Friesian calves), it meant that one had to find a butcher who was prepared to pay something like 5d. a lb. dead-weight for the sake of having a Hereford × Friesian calf. Unfortunately, he had not been able to find any butcher prepared to do that; that was why he suggested that the greatest profit would be from the Friesian.

On the question of the ratio of roughage to concentrates, a figure normally accepted was 1 of roughage to 2 of concentrates. But in the first few months, if the roughage: concentrate ratio was checked, it would be found that the roughage level was very, very low, and at that time, the calves were gaining 2½ lb. to 3 lb. a day, and doing it economically at 1s. down to 10d. lb. live-weight gain, which indicated that certainly a high level of roughage was unnecessary. If 9 cwt. were to be achieved in 12 to 13 months, roughage had to be restricted and a high quality type of food given in its place.

On the question of killing out percentage, a high concentrate diet would have a beneficial effect. Unfortunately, there is no direct comparison between the two groups of animals reared, but when silage was cut out altogether on the Friesian group, the killing out percentage was a little better than the Hereford × Friesian; killing out percentage could make a considerable difference to profitability.

Mr. Makinson, replying on the subject of restricted roughage, said that in their trials it had been decided to restrict roughage to 5 lb. a day; it was found, in fact, that for only 2 months out of a total of 12 months of the trial, did the animals eat 5 lb. a day. He did not know if it was dangerous to assume an animal knew what it wanted, but certainly veal calves obviously wanted fibre. With the older ones, an amount of hay was given which it was thought was adequate, and they did not, in fact, eat it. In the latter months, they were only eating 3 lb. a day, but nevertheless, it appeared to produce satisfactory rumination.

Mr. Wilson replied that he could not advance an opinion because he had not tried it, and it was difficult to comment on something one had not tried out. He saw no reason why the ratio of the roughage to the concentrates should not be cut down to the level suggested. There was no reason why a dairy cow should be any different from the beef animal. On the very high yielding herds, intake of hay was often very low indeed, coupled with the high concentrate rate of feeding.

Mr. A. Brownlee (Compton) said that the question has been raised about the amount of roughage which should be fed to cattle. At Compton groups of calves were fed on milk only and bedded with peat-moss litter. At autopsy, it was found that the rumen of these calves was filled with peat moss and that the rumen papillae had not developed. These findings indicate (i) that, in the absence of more palatable roughage, calves will eat peat-moss and (ii) that the presence of peat-moss in the rumen does not stimulate the development of the rumen papillae. Other calves, which ate a large amount of concentrates and only a relatively small amount of hay, showed well-developed rumen papillae.

Those, who had been to the Congress Scientific Exhibition, would have seen an exhibit showing that, in some cattle, the presence of a dark slate-coloured, iron-containing pigment on the epithelium of the rumen is met with. Work at Compton had shown that the degree of accumulation of this pigment varied with the diet fed. The work was not finished but it would appear that with high-concentrate feeding there is a tendency towards the accumulation of this pigment. Also, that if calves, which have been fed for a period on a large amount of concentrates (and thus, from analogy with other similarly fed calves examined *post-mortem*, presumably having this pigment present on the rumen epithelium), are thereafter fed on a diet of milk and hay, the rumen epithelium in these calves would be found on *post-mortem* examination to be pale in colour, indicating that the iron-containing pigment has been removed following the change in diet.

Mr. Wilson had raised the question of the animals sucking each other. Did the animals which were getting 3½ to 4 gallons of milk a day tend to do that? From the animal-behaviour point of view, it would appear that there is a drive on the part of the calf to suck; could that drive be extinguished by giving the animal a really liberal supply of milk, or would it still tend to suck even with a full stomach? Another question—did the high fat diet stimulate the development of the rumen papillae?

Dr. W. S. Gordon (Compton) spoke in connexion with the use of antibiotics as an aid to reducing mortality in young calves, especially when a large number was gathered together from several different sources. At Compton, they had considerable experience of assembling large numbers of newly born calves to enter certain experiments and in such transactions, preventive measures had to be taken to avoid serious mortality. This was a problem that probably faced those assembling broiler calves.

On one occasion at Compton, they had to assemble a group of 534 heifer calves to enter a brucellosis experiment. The animals were obtained in Ayrshire and delivered to a collecting farm when they were 1 to 5 days old, all being received within a period of 3 months. They were reared in Ayrshire for a period of 2 or 3 weeks and then transferred to Compton. This operation was carried out before the advent of antibiotics and a heavy mortality was expected. To allow for this, a greater number of calves was bought, 647 being offered to us but 55 were refused on delivery for various reasons, especially the appearance of scour: 592 were retained and of this number 133 died of enteric infections and pneumonic conditions, mostly within 3 weeks of birth. Thus, out of a total delivery of 647 calves, 459 became available to enter the experiment and 75 homebred calves were added to bring the total up to the 534 required. This is a vivid demonstration of the serious mortality from white scour and allied diseases that can occur when young calves from a variety of sources are assembled together.

With the advent of antibiotics, the position is now much more secure and it is clear that the addition of a broad spectrum antibiotic to the diet of young calves at the earliest opportunity can hold the mortality at a very low level. Thus, if 100 calves are required to enter an experiment, we find it possible to do this by purchasing about 105 animals, whereas previously it would have been necessary to buy about 150.

Our usual practice is to feed the antibiotic at a therapeutic level—approximately 300 mg. per calf—for a few days and if the calves are progressing satisfactorily, the level can then be dropped to a dietary level of about 45 mg. per calf per day.

No adverse effects or establishment of resistant strains had resulted from this procedure and evidence produced

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A Register of Animal Nursing Auxiliaries

The following official statement has been received from the Royal College of Veterinary Surgeons:—

FOR many years members of the veterinary profession engaged in research and teaching have been helped in their work by lay assistants. There are excellent training schemes for such workers and certificates awarded as a result of examinations give a clear indication of any laboratory technician's attainment in a particular field. These courses, in this country, where the technicians are working in laboratories, are both practical and theoretical. In general practice the need for lay assistance is no less, probably the only difference being the limitations imposed by the Veterinary Surgeons Act in relation to diagnosis and treatment. There is still a wide field where a veterinary surgeon may employ lay people to improve the efficiency of his practice.

In small-animal practice a class of lay workers, who have been wrongly styled veterinary or canine nurses, has come into being. Such workers are essential in any large, small-animal practice.

Many veterinarians have recognised the value of these workers and, from time to time, schemes have been suggested to give them formal training and recognition. During the last few years the Royal College has been working on such a scheme. It is designed to establish a suitable standard recognised by the award of a certificate and the formation of a Register of Animal Nursing Auxiliaries. When the scheme was first mooted it received a mixed reception by our own and by the nursing profession. The nursing profession, quite legitimately, took exception to the use of the designation "nurse" which, by law, is reserved for their own profession. As a result of discussions with the B.V.A., the original scheme has been considerably modified and it is now clear that there is a large body of opinion in the profession in favour of the proposed development. The Royal College, through an Animal Nursing Auxiliaries Committee, will be solely responsible for running the scheme but any proposed major alterations will be discussed with the B.V.A.

It has been made clear to the general public that the announcement of the scheme will not open up a vast new profession for young women leaving school. Its primary object is to establish standards in animal nursing by means of examinations which will be set annually by the R.C.V.S. Committee. A Register will be maintained by the College containing the names of those who have fulfilled the conditions for training and have reached the necessary examination standard and conform to certain other requirements.

In the past when a veterinary surgeon lost the services of someone who had been trained by him for this work, it was necessary to start to train someone quite inexperienced without there being any prescribed scheme of training. The responsibility lay entirely with the veterinary surgeon and made considerable demands on his time. Now it should be possible to employ someone who has attained a certain recognised standard in this field. In a small practice much of the practical training in the proposed scheme will still have to be supervised by the practitioner but in a large practice much will be done by a senior "nurse" who will accept a measure of responsibility for training in much the same way as is done by a matron in human medicine.

It is not visualised that the announcement of this scheme will bring a large influx of new entrants. Provision has been made to grant exemption from the two years' trainee period to those who have been employed by veterinary surgeons for a period of five years. They will still be required to sit the Preliminary and Final examinations. It will be possible for new applicants to be registered as trainees forthwith, if they are suitably qualified, and to enter for the Preliminary examination in the autumn of 1962 provided they are suitably employed in the interval. It is planned to hold the first Final examination in 1963. A booklet has been issued by the Royal College for the guidance of those interested in applying. In a foreword, the President of the R.C.V.S. draws attention to the Veterinary Surgeons Act of 1948 and reminds entrants of the limitations on the type of work for which they are being trained and that their work will be carried out under the direction of a veterinary surgeon.

The examination syllabus is not very extensive in the first place but, no doubt, changes will be made in the light of experience. An examination panel has been set up and includes many veterinary surgeons in practice who have taken an interest in this field. The booklet stresses that the Royal College's full responsibility in this matter is that of an examining body and it cannot possibly conduct courses of study for Animal Nursing Auxiliaries. It is hoped that where there is a sufficient demand, classes will be provided by local authorities in various subjects. Already in some large urban centres with hospitals, research institutes and universities, classes are held for labora-

(*Concluded at foot of col.* 1, *p.* 1321)

Intensive Rearing of Calves for Veal and Baby Beef.—*Concluded.*

by Dr. Edwards indicated that the population of *'coli* in the intestine was of 2 types—resistant and sensitive. When antibiotics were fed, the sensitive strains were depressed and the void created was filled by an increase in the number of resistant organisms. When the antibiotic was discontinued, the sensitive strains increased and the number of resistant strains was depressed. They had now purchased a large number of calves on several occasions and it was their practice never to do so without taking the precaution of supplementing the diet with antibiotics in order to keep mortality at a negligible level.

Mr. Wilson said that he thought sucking would still be found to occur even at high level feeding; the level of feeding did not overcome the desire of the calves to do so. He had had the same experience with pigs where food was *ad lib.*, and the same desire was there.

The Chairman said that it was with the greatest reluctance he had to terminate the very interesting discussion. It would be the wish of all that a hearty vote of thanks be proposed to Mr. Wilson, for the quality of his paper and the excellent way in which he introduced it, and to Mr. Makinson, for his most stimulating opening. He also thanked those who had taken part in the discussion on a very important subject.

Fog in Smithfield Show Week

BY

J. W. BARBER-LOMAX
Chorleywood

This year's Smithfield Show being almost upon us makes topical this interesting historical note.

MOST of us will remember, even if we did not experience, the disastrous fog which seriously disrupted the Smithfield Show in 1952. In the first week of December the ordinary citizen was given a taste of the type of "London particular" to which generations of Londoners had been subjected from time to time right back to the days when sea coal was first burned in the metropolis. During this week in 1952 the death rate in elderly people from bronchitis rose spectacularly.

Approximately 2 per cent. of the total cattle entries were affected by the unfortunate clash of fog, or what has come to be known as "smog," with the arrival at Smithfield of entries for the Show. Eight animals were slaughtered at the request of their owners before the exhibition was opened and 3 more died from respiratory trouble. The veterinary staff worked valiantly, and for 4 consecutive days and nights scarcely had any rest. At least 60 animals were treated for acute respiratory distress, many emergency cases were dealt with, and the press reported such disturbing facts as masks of sacking being soaked in whisky and draped over the nostrils of labouring beasts.

The Show of 1873

It is interesting to note that *The Veterinarian* of January, 1874, reported a terrible disturbance at the Smithfield Club Show of December, 1873, caused by the sudden occurrence of a dense fog during a sharp frost. Until this time fog had not been looked upon as "a deadly mixture destructive to animal life." On several occasions during the preceding 2 decades heavy fogs had occurred during the week of the Cattle Show but no serious consequences had resulted and no undue alarm was felt when on the second day of the Show the atmosphere became dense and pungent.

Before the fog had continued for many hours, however, some of the cattle in the Agricultural Hall, where the Show was being held, showed signs of distress. The Shorthorns, recognised in those days as more readily affected by disease than other breeds, were the first to succumb to the effects of the fog. By 11 o'clock in the morning several animals were seen to be breathing with difficulty. Towards the evening the fog became rather worse and by then the majority of the cattle in the hall showed evidence of distress.

Sheep and pigs did not, however, experience any ill-effects from the state of the atmosphere either then or during the remaining time of the Show and it is interesting that, in 1952, it was reported similarly that sheep and pigs in the stock lines, where about 1,200 animals were penned, appeared not to have been so distressed by the atmosphere as were the cattle.

On the Wednesday the fog showed very little improvement and the great majority of the cattle were so distressed that it was necessary to take some action both to relieve the animals and to satisfy their owners. The cattle which were most affected were taken from the hall into the entrance yard, and subsequently outside the gates, for what was rather ironically described as an "airing" although it was evident that conditions outside were no better than inside and in all probability were considerably worse.

The most exhausted beasts were given stimulant drenches of aromatic spirit of ammonia and ether but the circumstances were such that a consistent plan of treatment was not adopted for each individual case.

During the third night of the Show 91 cattle were removed from the hall for slaughter.

No fresh cases were reported on the Thursday and by that time the atmospheric conditions had improved. On Friday the air was comparatively clear and all the animals which remained in the hall were in normal condition.

In the general excitement and disturbance, with the added complication of spectators in the hall, it was not easy to make a careful appraisal of each case. It was evident, however, to the veterinary surgeons in attendance that the affected animals were suffering from asphyxia: it was found that they were exhibiting temperatures between 103° and 105° F.

The General Effect in London

In the Agricultural Hall it was the fat cattle which were most severely affected. *Post-mortem* examination of the slaughtered animals showed evidence of

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A Register of Animal Nursing Auxiliaries.—*Concluded.*

tory and animal technicians, covering some subjects of the course, for example, physiology and anatomy. Instruction for nursing and first aid will, in the first place, be a responsibility of the veterinary surgeon accepting a trainee, but, in time, no doubt, provision will be made for more formal instruction.

Anyone wishing to join the scheme will have to find employment with a veterinary surgeon who undertakes small-animal practice and has certain facilities which will be necessary for training in relation to hospital and surgical practice. Many people have devoted their lives to helping animals and there will be great advantage in a scheme which will encourage further training and give a tangible recognition of a certain standard of attainment in this field.

News and Comment

MAJOR W. H. WORTLEY

We are indebted to Professor R. Lovell for the following memoir.

Walter Hunt Wortley, of Bungay, died at a Norwich nursing home during the night of 5th/6th November, 1961. He was 70 years of age and was within a month of completing a year of office as Town Reeve, a year marked by quiet, faithful service.

His studies at the Royal Veterinary College were completed in July, 1914, and he thereby qualified as a Member of the Royal College of Veterinary Surgeons just before the outbreak of the First World War. Within about a month he was with the Army Veterinary Corps in which he served as a veterinary officer in France and Mesopotamia; he was demobilised in 1919 with the rank of Captain and a mention in despatches. There was a practice at Bungay which had been allowed to lapse for about a year and this attracted him; life was not easy in the early years and his method of transport ranged from a bicycle or motor bicycle to a horse which was sometimes ridden and sometimes driven. At the time of his death he and his partners served an extensive area in the Waveney Valley.

At the outbreak of the Second World War, Major Wortley, as he was then, returned to the Royal Army Veterinary Corps and spent about 2 years in Colchester and in Derby, from whence he returned to attend to his practice. His veterinary activities included a period as examiner for the final examination for Membership of the Royal College of Veterinary Surgeons, the Presidency of the Eastern Counties Veterinary Society and membership of the Council of the Victoria Veterinary Benevolent Fund.

His busy practice prevented him from taking the share in local affairs that he would have wished. He had been a Foundation Feoffee (a trustee of ancient and local charities) for about 11 years, and was proud to have been chosen Town Reeve. This is an ancient office and is the highest honour that

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Fog in Smithfield Show Week.—*Concluded.*

bronchitis; the mucous membrane of the smaller bronchial tubes was inflamed and there was lobular congestion and emphysema.

Apart from these alarming and serious consequences inside the hall, cattle in the open market at Islington, some from country districts and some from overseas, were also affected by the fog which, being essentially a London phenomenon, was a new experience for them.

A more telling circumstance was that London cattle, of which there were a great number in the Metropolitan cowsheds and which were accustomed to the usual "pea soupers," were also affected by this particularly pungent fog and became so distressed that their owners were "driven to seek veterinary aid" and in some instances had to have the affected animals butchered.

A Practitioner's Record

A London practitioner, Mr. Priestman, recorded details of the urgent cases he was called upon to treat in the cowsheds in his practice during the 2 worst days of the week. In 11 London districts he had to attend 48 severely affected cows out of 360 in the sheds; of these cases 1 died and 3 had to be slaughtered. All the distressed animals had temperatures elevated to 104° F.

In all cases Priestman adopted the same treatment. He prescribed 10 drops of tinct. aconite with half a drachm of nitrate of potash in a pint of cold water to be given as a drench and repeated the following morning. He ordered the doors and windows to be kept closed and the gas light to be left burning during the night. By the third day most of his patients were convalescent.

The majority of the affected animals were in good fit condition and had been in the sheds for some months: the others were fresh calved and in full milk. In those districts where the fog was densest the milking cows gave a markedly reduced yield but this drop in milk was only a temporary phenomenon and the recovered animals came back to their original yield.

Market Experience

The Inspector of the Metropolitan Market, Mr. Rayment, made the following report. On the second day of the fog an ox in the lairage was found to be breathing with great difficulty and evidently much distressed. The beast, which had a temperature of 103° F. was slaughtered and on *post-mortem* examination the lungs were seen to be emphysematous: no other signs of disease were seen.

During the second and third days of the fog 40 beasts from the Agricultural Hall were dressed in the slaughterhouses attached to the market. Some were brought in alive, others had been killed on the road from the hall to the market. The *post-mortem* examination showed in all cases emphysema of the lungs: in several cattle patches of congestion were seen in the lungs and the mucus in the bronchial tubes was quite black. In some cases there was emphysema to be seen beneath the peritoneal covering of the kidneys. Apart from the one beast found to be distressed in the market on the second day, several cattle were seen with similar symptoms on the following day.

A search of the literature might well show that similar circumstances had arisen between 1873 and the present day but reports of the 1952 disaster suggest that it had not been paralleled in living memory. With the extension of smokeless zones in all major cities it is unlikely that we shall witness such scenes again.

his beloved town of Bungay could confer upon him. The Prior Church of St. Mary was filled with some hundreds of people on Thursday afternoon, November 9th. They had come to pay their respects to him, and in addition to the family and personal mourners there were friends and representatives of organisations, societies and official bodies. Colonel J. Hickman, Mr. J. Stewart, Mr. R. G. Walker, Captain J. C. Taylor and Major H. A. Clay represented many of those organisations close to his professional life; these included the Royal College of Veterinary Surgeons, the Royal Army Veterinary Corps, the Ministry of Agriculture, Fisheries and Food, the British Veterinary Association, the Victoria Veterinary Benevolent Fund, the Eastern Counties Veterinary Society, the Royal Society of Health and the British Show Jumping Association. The Chairman and members of Bungay Urban District Council, and of the Town Trust joined with Mrs. J. C. Taylor, Mayor of Beccles and wife of the President of the Eastern Counties Veterinary Association in the Service. Officers, members and adherents of the Salvation Army and of the other churches were gathered together, with members of the St. John Ambulance Brigade, the British Legion, the Rotary Club, parish councils, banks and insurance companies, the Girl Guides and police, as well as clients and professional brethren from adjoining practices.

Walter Wortley was an East Anglian by birth and tradition. His school was one with a Methodist foundation in Suffolk and before attending the Royal Veterinary College he was articled as a pupil to a veterinary surgeon in Downham Market. East Anglia and Bungay in particular were very dear to him and he was proud of the house in Bridge Street where he lived for 40 years. It is an historic house and tales are told of its association with Huguenot refugees. It was fitting that the high office of Town Reeve should have been held by him, for he was very conscious of tradition and history. He loved animals, and horses, cows and many dogs roamed around the buildings and paddock. His knowledge and skill were given without stint and his ideals and sense of duty were revealed in his daily life. A characteristic gesture was his gift to the Victoria Veterinary Benevolent Fund shortly after the First World War, because he "wanted to show his gratitude for having come through the war unscathed." His honesty, generosity and integrity permeated all he did, and his professional and private life will live as an example to many.

He leaves 2 daughters by his first wife: Roma Pickard, the wife of a civil engineer, and Christine Glyn, the wife of a veterinary surgeon.

H. A. C. writes:—

It was with a very real sense of loss that his many friends learnt of Walter Wortley's death.

Settling in Bungay after service with the R.A.V.C. in the 1914-18 war, he devoted all his time and energy to the considerable practice which his skill and quiet confident manner soon established.

He served as an examiner in medicine to the R.C.V.S. for a number of years and, as a Territorial officer rejoined the R.A.V.C. on the commencement of war in 1939.

Members of the Eastern Counties Division, of which he was a past-President, will long remember the quiet humour with which he frequently added his observations to the subject under discussion, or recalled some appropriate anecdote to illustrate his view.

Those of us who spent our early years of practice in Bungay, will always be grateful for the example of professional integrity and skill which he himself never failed to set, and which he expected from those about him.

Of recent years he had found time to play an increasing part in the affairs of the community, and it was a source of universal satisfaction when he was honoured by election to the office of Town Reeve at the end of last year.

At the funeral Bungay church was completely filled by the host of friends, among them over 20 members of the profession.

Mr. R. G. Walker writes:—

I was privileged to be an assistant to Major Wortley for 3 years. He was a man of immense personal and professional integrity. Although he was himself a perfectionist and expected his professional associates to be the same, no one could have shown more understanding of the difficulties and mistakes that are inevitable in the new graduate just starting his professional career.

Like so many of his generation, his first love was the horse, on which he was an acknowledged authority, and its gradual disappearance was one of his greatest regrets.

As well as his undiminished enthusiasm for his work, I believe that his election as Town Reeve of Bungay gave him tremendous satisfaction, and was a fitting reward for a lifetime of altruistic service.

His final illness was mercifully short, for he could never have tolerated enforced inactivity.

The profession will extend its deepest sympathy to his two daughters on their bereavement.

MR. ROGER BROWN

A. M. H. writes:—

The tragic and untimely death of Roger Brown has been a great shock to all who knew him.

With his ready wit and his great good humour he made friends wherever he went. He had the courage to face a grievous illness and to overcome it; he had the gift of enjoying life as it came. He was an excellent companion and his going is an irreplaceable loss.

The sympathy of all his friends go out to his wife and children.

RETIREMENT OF MR. S. V. COLLARD

A reception and a dinner were held on November 8th in the Regent Hotel, Leamington Spa, by the L.V.I.s of Warwickshire in honour of Mr. Collard, their retiring Divisional Veterinary Officer.

Mr. W. P. Stokes presided over a company of 60, and the guests of honour were Mr. and Mrs. Collard

and their family. After dinner Mr. Howard Dawes gave a brief outline of Mr. Collard's career when he proposed his health, and presented him with a pair of field glasses and a cheque. At the same time Mrs. Collard was presented with a bouquet of roses and carnations

Mr. Collard saw service in the Royal Artillery in the First World War and afterwards graduated from London in 1924, Mr. Dawes said. He spent two or three years in practice in the Midlands before joining the Ministry of Agriculture and being sent to Somerset. He returned to Warwickshire in 1938 as Divisional Veterinary Officer and since that time had endeared himself to all those in agricultural practice by his friendly, helpful co-operation. Mr. Dawes added that proof of the esteem in which Mr. Collard was held was shown by the attendance at this dinner, the only absence being caused by work or illness.

Some of his many friends toast Mr. Collard.

In replying Mr. Collard thanked Mr. Dawes for his kind words and expressed his gratitude for both the presentation and the evening's festivities. He also expressed his appreciation of all the support he had received in his work in Warwickshire, and went on to reminisce about some of the veterinary surgeons who had supported him in his early days in the county.

The toast of the ladies was then proposed by Dr. Brook. The speeches were followed by informal conversation and story telling and the company left this very congenial party about midnight.

ROYAL SOCIETY OF HEALTH CONGRESS

The Royal Society of Health congress will be held in Scarborough from April 9th to 13th, 1962. The following programme has been arranged for the Veterinary Hygiene section which is being held on Thursday, April 12th, from 10 to 12.30 p.m., under the Presidency of Dr. W. R. Wooldridge.

"Meat Inspection Parasitology: its Interpretation and Economic Significance," by G. S. Wiggins, Assistant Veterinary Officer, Metropolitan Cattle Market, London.

"Practical Slaughterhouse Clean Meat Production," by A. Spreull, Superintendent of Markets and Slaughterhouses, City of Dundee.

FIRST MEETING OF VETERINARY RADIOLOGISTS

On Thursday November 16th, a meeting was held at 32 Welbeck Street, London, the premises of the British Institute of Radiology. It was intended to be of particular interest to veterinary surgeons, and was the first of its kind to be held under the Institute's auspices. The meeting was very well attended by both veterinary and medical radiologists. Among those present was the President of the R.C.V.S. Dr. Gordon Spear, President of the British Institute of Radiology presided.

Having welcomed members of the profession he explained that although the first skiagraph of an animal, and reference to X-rays in veterinary diagnosis, dated back more than 50 years this was the first meeting on veterinary radiology to be held.

Mr. Gordon Knight then gave a short and historical review on use of radiology in veterinary science. He showed an amusing plate of a dog which had swallowed a spoon, and belonged to Mr. Witherspoon.

Mr. J. J. Yeats showed a series of slides and plates demonstrating the methods of taking X-ray photographs of both hind and fore limbs, giving examples of pathological conditions found.

Messrs. Walker and Douglas showed a series of diagrams underlining the differences in shape (and hence approach) between the canine and human thorax, together with plates demonstrating various lesions, and the use of contrast media.

Each speaker underlined the problems of X-raying the unco-operative patient. Dr. Benzie, showed a series of plates of the intestinal tract of very young kids and lambs after a barium meal, thus providing a fascinating picture of the motion of the stomachs of the ruminant.

An interesting discussion followed these papers and demonstrations and at the close the President of the R.C.V.S., Mr. L. Guy Anderson expressed the thanks of the veterinary surgeons for the successful meeting, pointing out that it had, inter alia, demonstrated the necessity for a radiological society within the veterinary profession.

BRITISH EQUINE VETERINARY ASSOCIATION

At a meeting of approximately 100 veterinary surgeons held at the Royal Veterinary College, Camden Town, on November 18th, the British Equine Veterinary Association was formed. The main object of the Association is to maintain and stimulate interest in the horse by encouraging all members of the profession who have such an interest, be they engaged in practice, teaching or research, to meet together to discuss and exchange ideas and opinions. To this end it is planned to hold whole-day meetings in various parts of the country for the discussion of subjects and for visits to establishments of special interest to members. High priority is being given to the development of an abstract service of world literature concerning

the horse, and this will be distributed to members quarterly. In the scientific field the Association hopes to stimulate the interests of research workers in many unsolved problems, and if the demand arises to organise refresher courses. As a representative body of veterinary surgeons interested in the horse it is hoped that members can assist to preserve the place of the veterinary surgeon in all matters appertaining to the horse, and render to the profession and the public a balanced and informed opinion on equine problems.

TELEVISION BROADCASTS BY VETERINARY SURGEONS

Acting as honorary adviser on a series of monthly farming programmes to be shown on Southern commercial television, Mr. G. N. Gould has arranged for a number of veterinary surgeons who have specialised knowledge of particular subjects to take part. The first programme was broadcast last Sunday afternoon, the veterinary speaker being Mr. J. B. White, junior vice-President of the B.V.A. His subject was hypomagnesaemia, and it was illustrated by shorts from a film made by another member of the profession, Mr. P. R. Greenough. We understand that the broadcasting company has received a number of complimentary letters as a result of Mr. White's talk.

COMING EVENTS

December

5th (Tues.). NORTH WILTS. VETERINARY CLUB. Meeting at the Goddard Arms Hotel, Swindon, 7.30 p.m.

6th (Wed.). A.V.T. & R.W. SCOTTISH GROUP. Meeting in the Assembly Hall at the University of Glasgow Veterinary Hospital, Bearsden Road, Bearsden, 2.30 p.m.

B.S.A.V.A. MIDLAND REGION. Meeting in Simon's Lounge, Grand Hotel, Leicester, 8.15 p.m.

B.S.A.V.A. KENT REGION. Meeting at the Great Danes Hotel, Ashford Road, Maidstone, Kent, 7.45 p.m.

B.S.A.V.A. REGION NO. 2. Meeting at the Hotel Metropole, King Street, Leeds, 8 p.m.

MIDLAND COUNTIES VETERINARY ASSOCIATION. Joint meeting with the Worcestershire Veterinary Club at the Castle Hotel, Worcester Road, Droitwich, 8 p.m.

7th (Thurs.). AYRSHIRE VETERINARY ASSOCIATION. Meeting in the New Building, Auchincruive, 7.30 p.m.

CENTRAL VETERINARY SOCIETY. Meeting at the Royal Veterinary College, Camden Town, N.W.1, 6 p.m.

WEST OF SCOTLAND DIVISION. Meeting of the Clinical Club at the University Veterinary Hospital, 7.30 p.m.

8th (Fri.). WESTERN COUNTIES VETERINARY ASSOCIATION. Annual Dinner and Dance at the Rougemont Hotel, Exeter, 7 p.m.

BRITISH VETERINARY POULTRY ASSOCIATION. Meeting at Unilever House, London, 2.15 p.m.

13th (Wed.). NORTH OF ENGLAND VETERINARY MEDICAL ASSOCIATION. Annual Dinner Dance in aid of the V.V.B.F. at the Banqueting Rooms, Gosforth Park Race Course, Newcastle upon Tyne, 7.30 p.m.

SUSSEX VETERINARY SOCIETY. Meeting at the Old Ship Hotel, Brighton, 6 p.m.

SOCIETY OF PRACTISING VETERINARY SURGEONS. Joint meeting with the Cornwall Veterinary Clinical Club at the Red Lion Hotel, Truro, Cornwall, 7.30 p.m.

15th (Fri.). NORTH OF ENGLAND VETERINARY MEDICAL ASSOCIATION. Meeting in the Agricultural Lecture Theatre, King's College, Newcastle upon Tyne, 7.30 p.m.

ADDRESSES OF DISEASE INFECTED PREMISES

The list given below indicates, first the date on which disease has been confirmed, followed by the postal address and local authority.

Anthrax

November 27th, 1961. W. Downie, Newfield Farm, Stranraer, Wigtownshire (Parish: Leswalt). (Cattle.) WIGTOWNSHIRE.

November 27th, 1961. F. Blackshaw, Dirtlow Farm, Ashford, Bakewell, Derbys. (Parish: Ashford). (Cattle.) DERBYSHIRE.

November 27th, 1961. J. R. Meeker, Church Farm, Kilmington, Warminster, Wilts. (Parish: Kilmington). (Cattle.) WILTSHIRE.

November 27th, 1961. B. S. Drake, Stookfield Farm, Droop, Hazelbury Bryan, Sturminster Newton, Dorset. (Cattle.) DORSET.

November 27th, 1961. J. & R. Tasker, Pevlings Farm, South Cheriton, Templecombe, Somerset (Parish: Horsington). (Cattle.) SOMERSET.

November 27th, 1961. A. D. Orme, Sopers Bridge Farm, Stoney Stanton, Leicester (Parish: Stoney Stanton). (Cattle.) LEICESTERSHIRE.

November 27th, 1961. D. J. Fluke, Couchill Farm, Beer, Seaton, Devon (Parish: Beer). (Cattle.) DEVONSHIRE.

Fowl Pest

November 24th, 1961. W. J. Watson & Son, Thornfield Dairy Farm, New Lane, Malton Road, York. YORK, NORTH RIDING.

November 24th, 1961. S. A. & J. E. Nearey, West View, Hart Hall Lane, King's Langley, Herts. HERTFORDSHIRE.

November 24th, 1961. H. W. Sage, The Homestead, North Lopham, Diss, Norfolk. NORFOLK.

November 24th, 1961. W. Wright & Sons, Upgate Farm, Carleton Rode, Norwich, Norfolk. NOR 03X. NORFOLK.

November 24th, 1961. A. J. Hemmings, Avon Valley Nursery and Poultry Farm, Stony Lane, Christchurch, Hants. HAMPSHIRE.

November 24th, 1961. A. E. Pretty, Heath Road, Banham, Norwich, Norfolk. NOR 05X. NORFOLK.

November 24th, 1961. Mrs. E. Perry, Poplar Villa, The Reddings, Cheltenham, Glos. GLOUCESTERSHIRE.

November 24th, 1961. J. F. Bomford Ltd.; Spring Hills, Pershore, Worcs. WORCESTERSHIRE.

November 25th, 1961. J. F. Bomford Ltd.; Pershore. Disease at: Lower Moore Farm, Pershore, Worcs. WORCESTERSHIRE.

November 25th, 1961. Miss B. S. Wood, Firsfield Lodge, Kenninghall, Norwich, Norfolk. NOR 06X. NORFOLK.

November 25th, 1961. H. Wood, 1, Beaulah Place, Upshire, Waltham Abbey, Essex. ESSEX.

November 25th, 1961. J. F. Bomford Ltd.; Barton Farm, Barton, Bidford-on-Avon, Alcester, Warwick. WARWICKSHIRE.

November 25th, 1961. P. Robinson, Ludgate in Causeway, Eye, Suffolk. EAST SUFFOLK.

November 26th, 1961. H. D. Ham, Gables Farm, Badgeworth Lane, Shurdington, Cheltenham, Glos. GLOUCESTERSHIRE.

November 26th, 1961. Mrs. L. Smith, West Church Street, Kenninghall, Norwich, Norfolk. NOR 06X. Disease at: Market Place, Kenninghall, Norwich, Norfolk. NORFOLK.

November 27th, 1961. Mrs. A. Alderton, No. 14, The Ling, Garboldisham, Diss, Norfolk. NORFOLK.

Swine Fever

November 24th, 1961. I. W. Strachan, Balguain Mains, Inverurie, Aberdeenshire. ABERDEENSHIRE.

November 24th, 1961. J. S. Watson, Muir of Pert Farms Ltd.; Tealing Airfield, Tealing, Dundee, Angus. ANGUS.

November 24th, 1961. H. Newton, Trevors Close Farm, Gawsworth, Macclesfield, Ches. CHESHIRE.

November 24th, 1961. S. G. C. Taylor, Sharon, Hambledon Road, Denmead, Portsmouth, Hants. Disease at: Forest Road Piggeries, Denmead, Portsmouth, Hants. HAMPSHIRE.

November 24th, 1961. A. Taylor, Hillcroft, West End Road, Norton, Doncaster, Yorks. YORK, WEST RIDING.

November 27th, 1961. E. H. Evans, Upper Cantref Farm, Brecon. BRECKNOCK.

November 27th, 1961. S. Roberts, Eardisley, Tan-yr-Allt Avenue, Mochdre, Colwyn Bay, Denbighs. Disease at: Llidiat-y-Pyllau, Conway Old Road, Mochdre, Colwyn Bay, Denbighs. DENBIGHSHIRE.

November 27th, 1961. W. M. Taylor & Sons (Hull) Ltd.; The Willows, Halsham, Hull, Yorks. Disease also at Willow Cottage, Halsham, Hull, Yorks. YORK, EAST RIDING.

November 27th, 1961. F. E. Rout, Shepherd & Dog Piggeries, Felixstowe Road, Nacton, Ipswich, Suffolk. EAST SUFFOLK.

November 27th, 1961. Messrs. Henderson & Denham Smith, Lime Tree Farm, Stradbroke, Diss, Norfolk. NORFOLK.

November 27th, 1961. R. H. Brassington, Oak Lane Farm, Calf Heath, Wolverhampton, Staffs. Disease also at: Smallholding, Woodland Lane, Four Crosses, Cannock, Staffs. STAFFORDSHIRE.

November 27th, 1961. The Livestock Group of Companies (Manager C. S. Woodward), Rose Tree Farm, 29, Nine Mile Ride, Finchampstead, Berks. BERKSHIRE.

Letters to the Editor

The views expressed in letters addressed to the Editor represent the personal opinions of the writer only and their publication does not imply endorsement by the B.V.A.

Neonatal Scouring in Piglets

Sir,—Writing as a general practitioner of a few years' experience, I find that "Ferrosul"* capsules are still very efficacious in dealing with neonatal scouring in piglets. These capsules contain a bacteriostatic agent and a mineral "cocktail" of iron, copper and cobalt. In many instances I find that one administration is sufficient.

Yours faithfully,
R. A. ANDERSON.

60, Main Street,
Cayton,
Scarborough.
November 22nd, 1961.

* Crookes Laboratories Ltd.

R.V.C. East Africa Expedition, 1962

Sir,—I should sincerely like to thank all the London graduates who have contributed towards the R.V.C. East Africa Expedition. Since the estimated cost of the expedition is £5,170, any further contributions will be most gratefully received.

The prospectus of the expedition will be published shortly, and duplicated copies will be sent to all contributors as soon as they are available, together with an official receipt.

We are pleased to announce that H.R.H. the Duke of Gloucester, K.G., has kindly agreed to act as our Patron in Chief, and our list of patrons also includes Sir Howard Florey, President of the Royal Society, and Sir Julian Huxley.

Yours faithfully,
JOHN O. BROBERG,
Hon. Secretary.

Royal Veterinary College,
Royal College Street,
London, N.W.1.
November 22nd, 1961.

Increase in *Post-mortem* Examination Charges

Sir,—With effect from January 1st, 1962, the Station's charges for *post-mortem* examinations will be increased. The new charge for examining an adult bird or, in certain circumstances, a group of related birds sent in at the same time from any one outbreak, will be 20s. and for a batch of chicks, 6 weeks of age or under, 30s.

Clients are reminded that as a disease precaution the Station cannot accept any *live* specimens for clinical observation.

Yours faithfully,
R. F. GORDON,
Director.

Houghton Poultry Research Station,
Houghton,
November 15th, 1961.

Intraperitoneal Medication of Cattle

Sir,—When I described the technique of intraperitoneal injection in cattle at the Central Veterinary Society symposium on "Clinical Problems in Everyday Practice" (Stratton, 1957), I made no claim to originality as I had been introduced to the technique by Mr. F. G. Waddington. My purpose was to stimulate interest in this useful method of medication. Mr. Ranson's recent letter reminds us that he was using this technique 20 years ago (Ranson, 1943).

Swarbrick (1961) is to be congratulated on his wide use of the method. He prefers the right flank approach but I have always found the left flank to be satisfactory in adult cattle except when there was any degree of rumenal tympany. If the right flank is used the possibility of penetrating the intestine is remote but if it does occur it is unlikely to be appreciated by the operator. Whereas if the left flank is used there is no doubt if the needle either strikes or enters the rumen.

The left flank approach is unlikely to injure any vital organ. On the other hand the right flank

approach may, as in the case cited by Swarbrick in a calf, injure the right kidney or even the left kidney, for when the rumen is full the left kidney is displaced to the right being found posterior and slightly ventral to the right kidney.

Yours faithfully,
JOHN STRATTON.

Royal Veterinary College,
Department of Medicine,
Royal College Street,
London, N.W.1.
November 22nd, 1961.

References

RANSON, T. Y. (1943). *Vet. Rec.* **55.** 131.
STRATTON, J. (1957). *Ibid.* **69.** 672.
SWARBRICK, O. (1961). *Ibid.* **73.** 1,078.

Downing's " Instructions "

Sir,—Mr. Barber-Lomax in his interesting letter about Downing, says that John Lawrence in his " Philosophical and Practical Treatise on the Horse " (1798) gives no hint of Downing's plagiarism of Topham.

When Lawrence's book first appeared he had not " had an opportunity to peruse " Topham's book. However, I have a copy of the first volume of the third edition (1810) of Lawrence's work in which he revises his opinion of Downing as follows:—

" My acknowledgments to Dr. Downing have been sufficiently liberal. The Doctor's book, I have at last discovered, to be a tolerably accurate copy of Topham on the Diseases of Cattle."

Sir Frederick Smith, who had read this third edition, confirms Lawrence's view.

Yours faithfully,
R. A. ASHCROFT.

84, Belfield Road,
Etwall,
Derbys.
November 20th, 1961.

Dry Coat in the Race-horse

Sir,—Mr. Marsh's article on dry coat in the race-horse in Malaya was of considerable interest to me. In his final paragraph he remarked that " we have not solved this problem " and asks " why some horses go dry and others do not."

I have raced my own horses in all parts of India and, in my capacity as Commandant of the Army Veterinary School, Poona, for 4 years, have had many dry-coated horses from the numerous racing stables there, under treatment in the extensive hospital of 50 boxes, the inmates of which were used in teaching officers and men animal management. I may, therefore, be able to assist your correspondent in understanding and dealing with this problem.

The British Thoroughbred horse is a product of imported Arabian Barb and Turk horses of high-class stock brought into England in the 17th and 18th centuries to be mated with the indigenous running mares. These horses had an inherited ability to stand tropical heat at its highest and were able to transmit to their progeny a considerable degree of resistance to heat. When transferred to tropical and sub-tropical countries, they were usually able to race under such conditions. Some, however, did not apparently acquire sufficient resistance and broke down with failure of the sweating system, followed by the necessity for the respiratory system to take over the load. Usually such breakdowns take place when the heat is considerable and very humid, and when horses, highly fed, are working and racing at top speed, having often had their appetites stimulated by tonics such as arsenic in its different forms.

The horse is not the only animal from a temperate zone whose heat control system can be influenced by the use of males indigenous to tropical countries. Twenty-five years ago the King Ranch of Texas began to revolutionise its breeding system based on shorthorn cattle which became severely distressed in hot weather, by the introduction of Brahma bulls. Using a half-bred bull to commence with it was found that the first progeny of this mating with 25 heifers were 300 lb. heavier than any the Ranch had previously bred. To-day the Santa Gertrudis breed of cattle with approximately two-fifths Brahma and three-fifths shorthorn blood are being exported all over the tropical world at very high prices.

The reverse of the above may be of interest. My duties as a senior officer brought me into contact with the military dairy farms where I saw and reported on the disastrous results arising from injudicious up-grading, by Friesian bulls, of the indigenous stock which were unaffected by tropical heat. The first cross produced good cattle with greatly improved milk records, but in the second many became what I call " panters "; and in every succeeding upward grade the percentage of deterioration became higher. The symptoms were a temperature of up to 108°, distressed breathing and a long harsh coat out of season. High milkers, particularly those fed on grain, were most severely affected, but in dry animals these symptoms were ameliorated. Calves at birth were two-thirds normal weight, and there was a progressive decline in milk yields.

Affected cattle were passed on to the civil department for observation and treatment but no recoveries were seen during my time. With cattle, reversing the breeding might produce satisfactory results, but it would not be practical in the race-horse.

My experience included, in a few cases, the use of a diet entirely of freshly cut lucerne, but though coats recovered their bloom, after 6 weeks in training it was lost. I found that many of my cases had gastritis in that lavage with large quantities of saline removed masses of thick tenacious mucus, as a result of which with 2 weekly doses horses seemed to do better and a satisfactory number managed to climb into higher classifications. While I think that this condition can be ameliorated I doubt the possibility of it being cured by medicinal methods.

Captain Marsh will probably continue his present treatment, but in view of the expense he might perhaps try lucerne, green and as hay, but certainly in large quantities in the off season.

My *post-mortem* findings were of considerable interest and, if chemical analysis is available, he may, I think, find enlarged spleens up to 25 lb. or so and the other organs will indicate whether or not

arsenic has any part in this condition. Histological examination of the sweat glands from the dry portions of the skin may be equally interesting. In the event of finding enlarged spleens dissection of the splenic nerve may indicate the cause, and it might also be interesting if the vagus nerve could be examined in cases where horses die immediately after a race or fast gallop. He might also encourage trainers to reduce heavy feeding. A training genius in Bombay never fed more than 12 lb. daily to any horse in his stable.

Yours faithfully,
C. M. STEWART.

Dowdstown House,
Maynooth,
Co. Kildare.
November 15th, 1961.

Experience with a Tranquilliser

Sir,—We feel that it may be of interest to offer some preliminary comments and observations upon yet another "tranquilliser" in the veterinary field.

Acetylpromazine maleate has been available to veterinarians in Canada for the past 2 years, and in this practice is employed as both a preanaesthetic agent, and as a "tranquillizer." It has been found consistently successful in both of these uses.

It may be administered by intravenous, intramuscular, subcutaneous and oral routes. Parenterally, the intramuscular route is the most reliable, and in small animals induces a predictable level of sedation within 15 minutes. The drug is especially valuable as a tranquilliser of vicious and nervous dogs, and subsequent external stimuli fail to produce the undesirable exaggerated response often associated with other agents. One may comment here upon the psychological make-up of the canine animal; not infrequently one injection of acetylpromazine to a nervous dog has a lasting effect upon its attitude towards the veterinarian, and subsequent handling presents no problem.

Used as a preanaesthetic agent in small animals, the narcotic excitement of induction is eliminated and the subsequent barbiturate dose required to induce surgical anaesthesia is reduced to approximately one half of the normal computed dose. The time that the animal remains in a surgical plane is considerably shortened. The residual effects of acetylpromazine persist for up to 8 hours, and eliminate post-anaesthetic excitement.

There appears to be little or no passage of the drug across the placental barrier. We have used acetylpromazine - pentobarbitone anaesthesia in caesarean section in the dog, and have delivered pups alive, although still under light anaesthesia. We would not recommend such a procedure as the one of choice, but suggest that it might be of use to the single-handed practitioner without a competent anaesthetist.

We have found, in small animals, that the full dose recommended by the manufacturing company is not, in many cases, necessary to produce maximum effect. It is our practice not to exceed a maximum dose of 25 mg. regardless of the dog's size. (Recommended dose rate: up to 10 mg. for 20 lb. bodyweight.) In no case has there been any evidence of toxicity.

Acetylpromazine may also be used in large-animal practice. Its effect upon large animals is profound, and a relatively small dose is employed. For handling or transporting semi-wild cattle it is most valuable.

Upon the horse its effects are more predictable than are those of any other agent of a similar nature known to us. Occasionally an atypical response is encountered, but in general the animal becomes quieter and more tractable, and does not show an exaggerated response to external stimuli.

In both cow and horse inco-ordination may occur with relatively small doses, and the time taken to obtain maximum effect is somewhat unpredictable. Animals may become unexpectedly recumbent at any time during surgical intervention in the standing position. This should be remembered if it is intended that acetylpromazine be used when performing such operations as caesarean section upon the bovine animal under local anaesthesia. Intervention upon the standing animal using posterior epidural anaesthesia may also become somewhat hazardous.

We realise that many of the properties of acetylpromazine apply also to other agents currently available. However, we think that in its wide application, and its most effective tranquillising action it is indeed worthy of note.

Yours faithfully,
T. VAN LAUN,
L. B. NETTLETON,
N. G. JAPP.

Truro Animal Hospital,
Cornwall.
November 1st, 1961.

DISEASES OF ANIMALS ACT, 1950—GREAT BRITAIN
Summary of Returns of Confirmed Outbreaks of Scheduled (Notifiable) Diseases

Period		Anthrax	Atrophic Rhinitis	Foot-and-Mouth	Fowl Pest	Sheep Scab	Swine Fever
1st to 15th November, 1961		10	—	—	39	—	36
Corresponding period in	1960	6	—	113	100	—	66
	1959	16	—	—	251	—	75
	1958	2	—	—	25	—	38
1st January to 15th November, 1961		207	—	103	992	—	958
Corresponding period in	1960	175	1	143	1,690	—	1,068
	1959	224	2	9	979	—	1,133
	1958	139	5	116	642	—	1,107